ENGINEERING AND PRODUCTION IN METALWORKING APRIL, 1961

Machinery

There's nothing to equal
Monarch flame-hardened
lathe beds for retained
original accuracy

See advertisement Page 32

Monarch
TURNING MACHINES

INTERNAL GRINDING...

Are Two Wheels Better Than One?

by George H. Lockwood
Manager, Research & Development
The Heald Machine Company

Until very recently, internal grinding of a straight or taper bore has always been done with a single grinding wheel. Although this method has worked very well and will continue to be widely used, it is subject to inherent limitations under some circumstances.

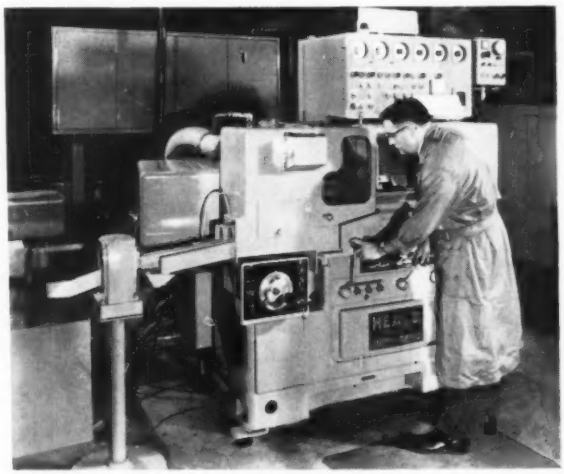
In the first place, using the same wheel for both rough and finish grinding requires a compromise in grit selection. A wheel coarse enough for maximum efficiency of stock removal in the roughing portion of the cycle may not give a sufficiently smooth surface for the finish grinding operation. So grinding speed must be weighed against surface finish, and a suitable compromise selected.

Secondly, in single-wheel grinding the wheel is usually dressed between the rough and finish portions of each grinding cycle. This increases the total cycle time by the time necessary for the dressing operation.

Both of these limitations have been removed by a unique double-wheel grinding arrangement which was first demonstrated publicly by Heald at the 1960 Machine Tool Exposition. This setup uses a single wheelhead with two separate wheels mounted on the same spindle—one for rough grinding and the other for finish grinding (see diagram below). Actual wheel specifications can be determined on the basis of maximum performance—a coarser roughing wheel for faster stock removal and a finer finishing wheel for a lower micro-inch finish. Change from rough grinding to finish grinding is simply a matter of automatically changing the position of the machine table, with no interruption of the cycle. Both wheels are dressed while the work is being loaded, hence dressing adds no time to the cycle. This represents a significant reduction in overall cycle time.

With these resultant advantages—more efficient rough and finish grinding plus no time out for dressing—a workpiece that would ordinarily require 25 to 30 seconds on a single-wheel machine, can now be ground in less than 10 seconds by the two-wheel method.

This new method is ideally suited to high production runs where maximum output is essential. But it is not the universal solution to all grinding problems. Wheel costs may run somewhat higher, since both wheels are normally dressed during each cycle and as much is removed from the finishing wheel as from the roughing wheel. An economic study of your particular requirements will show which method—one wheel or two—will yield the maximum return on your machine investment.



Heald Model 190A Centri-Matic internal grinding machine arranged for high speed double-wheel grinding of bearing races.

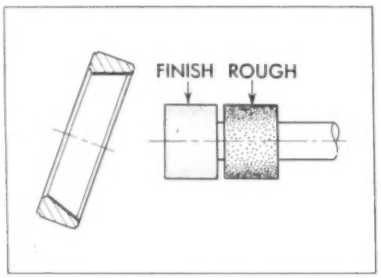


Diagram of double-wheel setup for grinding taper I.D.s of bearing outer races. The roughing wheel is mounted nearest to the wheelhead to reduce spindle deflection under heavy feeding pressure.

Your Heald engineer will be glad to tell you more about this interesting development. **It PAYS to come to Heald.**

THE HEALD MACHINE COMPANY
Subsidiary of The Cincinnati Milling Machine Co.
WORCESTER 6, MASSACHUSETTS

APRIL 1961

VOL. 67 No. 8

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Machinery

THE MONTHLY MAGAZINE OF ENGINEERING AND PRODUCTION IN THE MANUFACTURE OF METAL PRODUCTS

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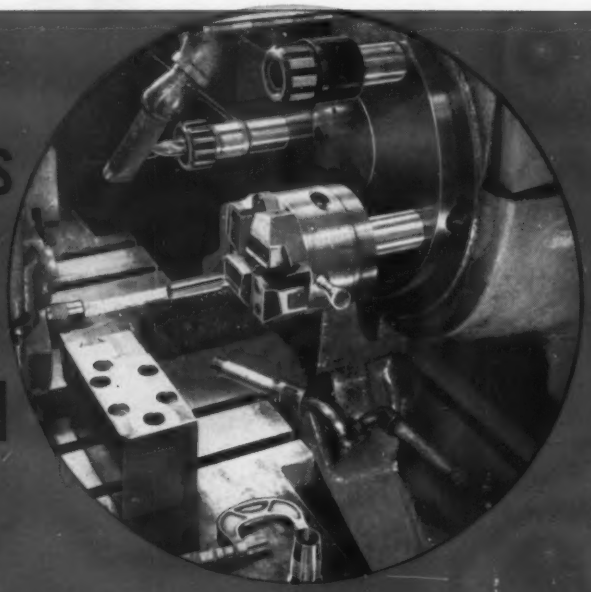
LANDIS chasers last 6 times longer than form tool



A Landis 1¼" FD LANDMATIC Die Head equipped with Landis Tangential Chasers is shown threading nipples at the Pershing Machine Company, Jackson, Michigan. Chaser life is 6 times longer than that of the form tools used.

The LANDMATIC Die Head is mounted on a 2½" AD Cleveland Diamatic Machine and produces 1-1/16" diameter, 18 pitch NEF, Class 2 threads 1" long on Monel metal.

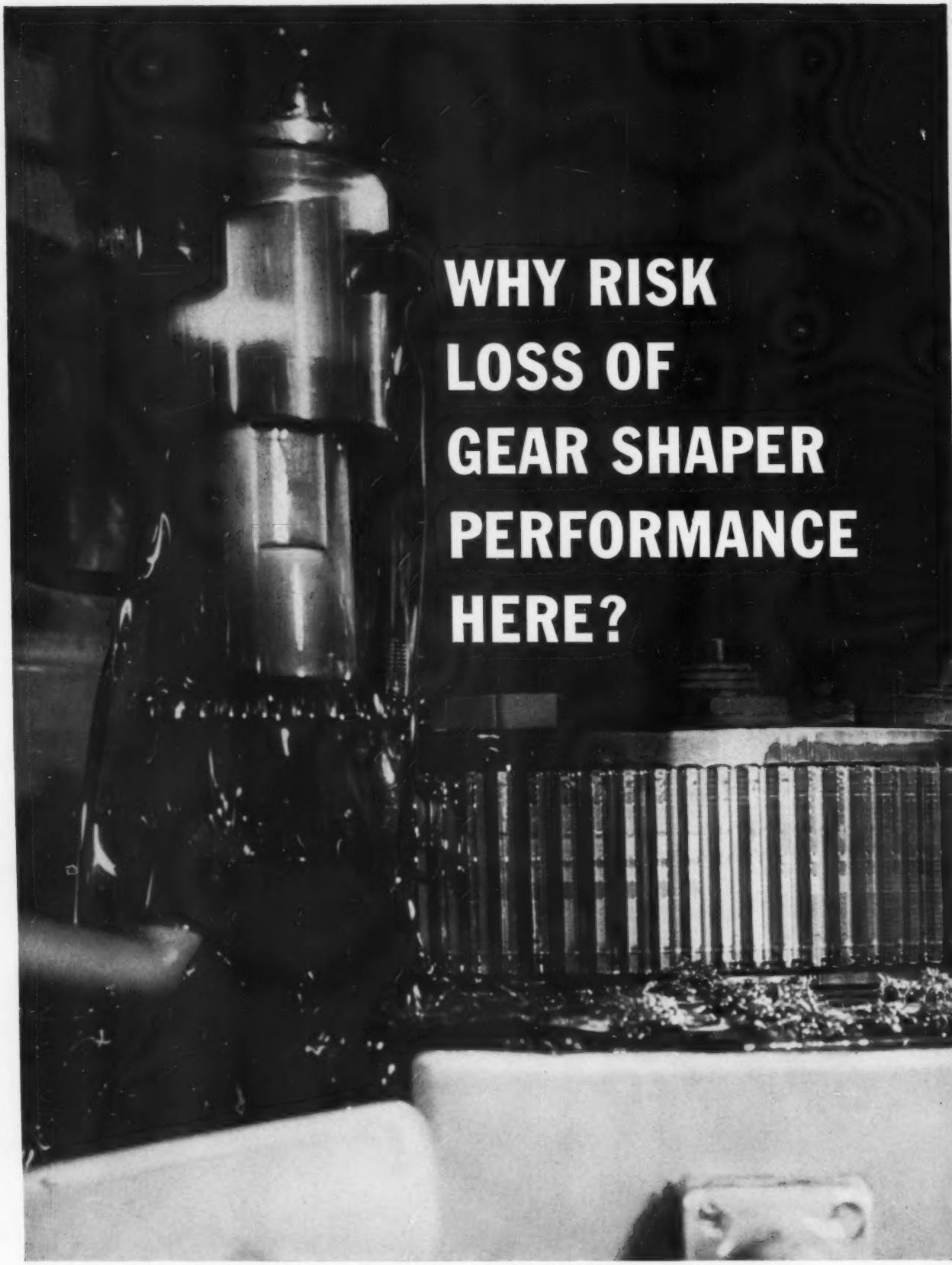
The form tools produce only 10 pieces between grinds and the drills, also used in this operation, produce 100 pieces. Besides having a much longer chaser life, the LANDMATIC Head produces 100 pieces between grinds equalling the drill life. The LANDMATIC Head also produces excellent thread finish and size control.

The Standard FD LANDMATIC is a self-opening, manually-closed, heat-treated die head for application to turret lathes, hand screw and automatic screw machines, chucking machines and other equipment using a nonrotating type tool. However, when the tool is to be placed on automatic equipment where automatic closing is required, such as in the operation at Pershing Machine Co., the FD LANDMATIC incorporating overtravel is recommended. The FD LANDMATIC can be cam-closed through special closing pins or closing bushings. This overtravel feature eliminates the need for a complicated, accurately-set closing cam.

For complete information on LANDMATIC Die Heads, please request Bulletin F-90.

LANDIS *Machine* COMPANY
WAYNESBORO • PENNSYLVANIA
The world's largest manufacturer of threading equipment

604C


WHY RISK
LOSS OF
GEAR SHAPER
PERFORMANCE
HERE?

Give your products all the high-production, high precision advantages of Fellows Gear Shaper performance by tooling up with Fellows cutters.

The better design of Fellows cutters is the result of advanced engineering techniques, including the use of a high-speed computer for solving design and application problems. Their better quality is the result of constant advances in metallurgy and manufacturing methods. And, proof of their better performance are the thousands of Fellows cutters in use on modern gear production lines.

Fellows cutters on Fellows machines lower costs and speed production on external and internal, spur and helical involute gears and a wide variety of non-involute shapes as well. All Fellows Offices are at your service for providing information.

THE FELLOWS GEAR SHAPER COMPANY
78 River Street, Springfield, Vermont, U.S.A.
Branch Offices:
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THE PRECISION LINE **Fellows** *Gear Production Equipment*

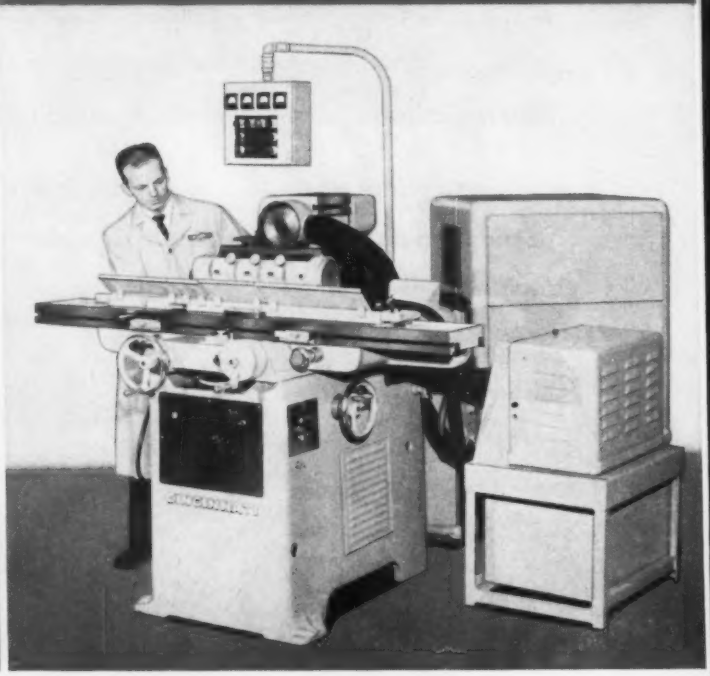
For more data circle this page number on card at back of book

CINCINNATI offers you 3 types

ELECTRICAL DISCHARGE MACHINES

CINCINNATI Electrical Discharge Machine — one of 32 sizes and styles built to handle a wide variety of parts. Left: copper anode for an electron tube, in which slots were electrical discharge machined in outer wall.

ELECTROLYTIC GRINDING MACHINES



CINCINNATI Electrolytic Grinding Machine — for "grinding" carbide tools and small parts like the needles at the left, which cannot tolerate burrs or metal smear.

CINCINNATI

KNEE TYPE AND BED TYPE MILLING MACHINES • DIE SINKING MACHINES • CUTTER AND TOOL GRINDERS •

THE CINCINNATI MILLING MACHINE CO., CINCINNATI 9, OHIO

# of electrical machining equipment...

There are three general classifications of electrical machining, each having particular advantages that solve production problems across the complete field of metalworking. Cincinnati Milling builds equipment for all three, and is prepared to show you the potential for widening design horizons and reducing costs in your shop.

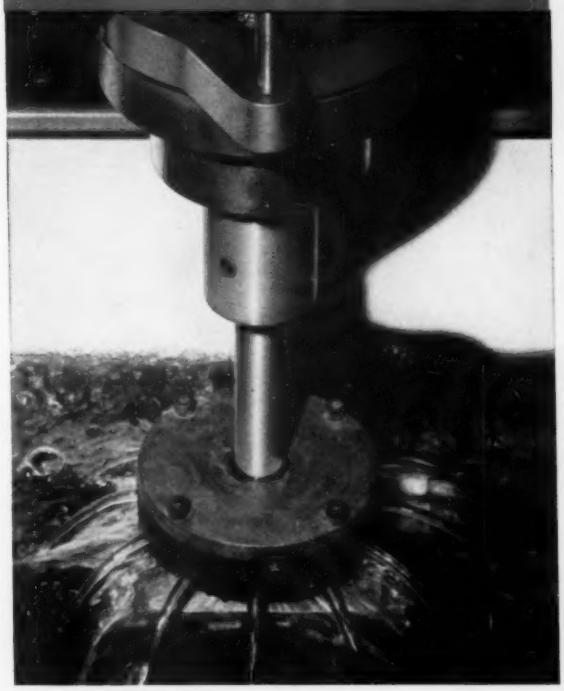
1. *CINCINNATI Electrical Discharge Machines* greatly extend the abilities of the EDM process. Applications include forming, piercing and die sinking on any electrically conductive material, regardless of its hardness and fragility, or unusual geometry of the operation. Cincinnati builds 32 basic EDM machines.

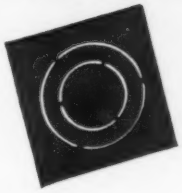
2. *CINCINNATI Electrolytic Grinding Machines* handle a wide variety of general-purpose and cutter and tool grinding applications, offering substantial savings in grinding wheel costs and in grinding time on carbide cutters. Electrolytic grinding produces a burr-free surface that is metallurgically undisturbed. Metals that are ordinarily hard to machine or subject to thermal damage can be handled easily and safely because of the "cold machining" nature of the process.

3. *CINCINNATI Electro-Chemical Machines,* for vertical feed, through-hole production applications in hard-to-machine metals. ECM leaves a burr-free surface with no thermal change, opens new areas of cost reduction.

Which Electrical Machining Process is best for you? Cincinnati has the knowledge and experience to apply the right process to solve your particular machining problem. We will appreciate the opportunity to tell you more.

ELECTRO-CHEMICAL MACHINES





CINCINNATI Electro-Chemical Process—used to machine narrow circumferential slots through tough steel.

VERTICAL BROACHING MACHINES • ELECTRICAL MACHINING EQUIPMENT

CINCINNATI®
MILLING MACHINE DIVISION

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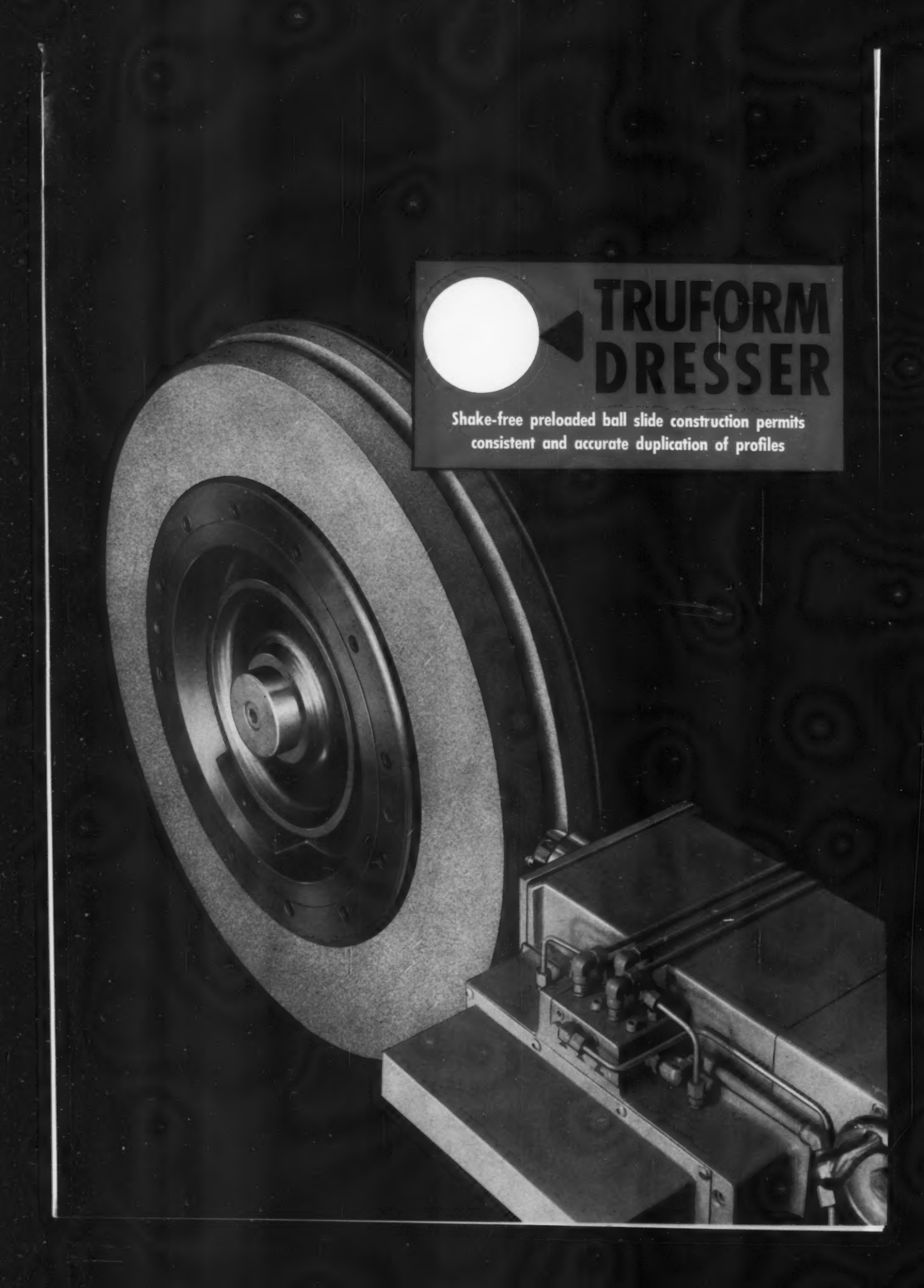
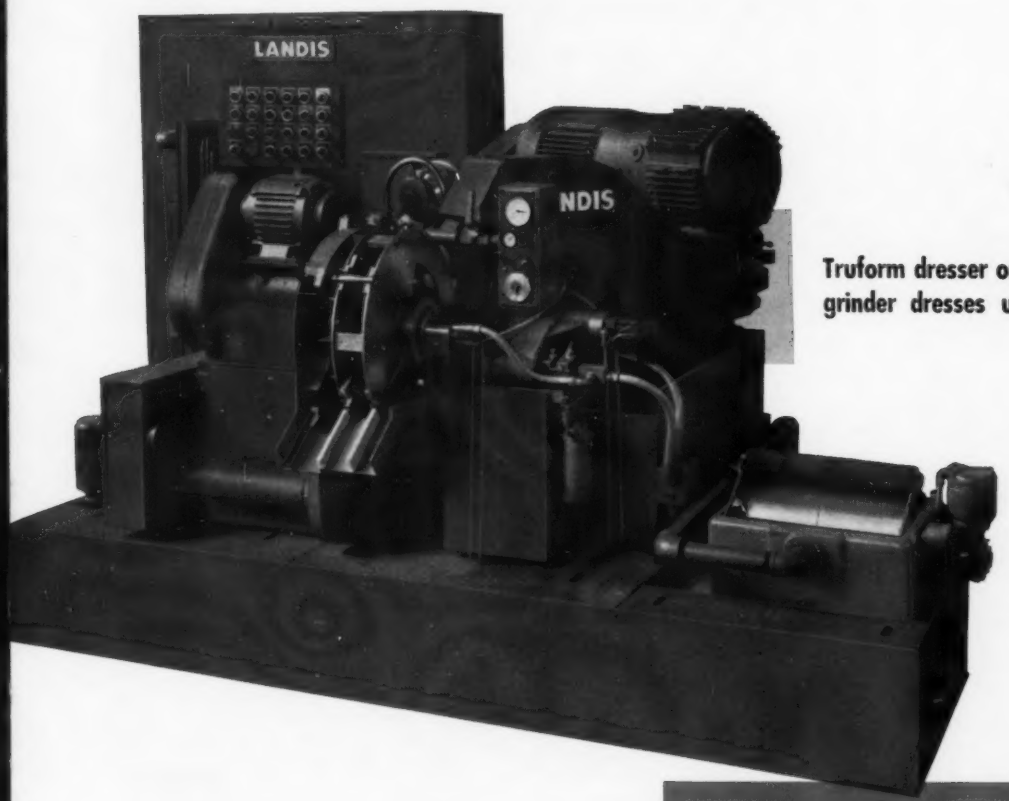

TRUFORM
DRESSER
Shake-free preloaded ball slide construction permits
consistent and accurate duplication of profiles

Landis Truform dresser adds new accuracy to cylindrical grinding

- assures exact duplication of profile on the wheel
- delivers consistent, repetitive accuracy with minimum attention
- eliminates time lost in reworking profile bars
- dresses profiles in either direction up to 60°
- saves on diamond costs
- available on many new Landis grinders



Truform dresser on Landis plunge grinder dresses unusual profiles

LANDIS

world leader in precision grinders

LANDIS TOOL COMPANY, WAYNESBORO, PA.

R B & W FASTENER BRIEFS

RUSSELL, BURDSALL & WARD BOLT AND NUT COMPANY

Technical-ities

By Fred E. Graves

Fastening of joints in corrosive environment

For a fastener to stand up in a corrosive environment it must either be coated, or made from an anti-corrosive metal.

THE METALLIC COATINGS

The "workhorse" applications are satisfied most economically with SAE Grade 2 or Grade 5 fasteners. Required outdoor durability is achieved with a plated or a hot galvanized finish. Hot galvanizing complicates good thread fits, costs more than plating in the popular size range, but gives much greater protection than any commercial plating.

A heavy galvanized coating is not recommended on highly stressed fasteners. If you need the high strength of Grade 5 bolts and want them corrosion-resistant, zinc plating should be your first choice. Certain conditions may require cadmium, nickel or copper plate.

THE ENDURING METALS

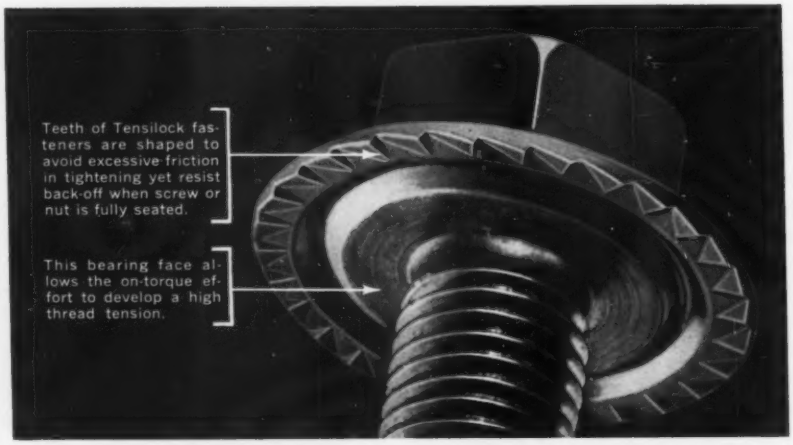
While each metal poses problems in certain applications, stainless steel, aluminum, and silicon bronze all offer distinct advantages.

Silicon bronze is popular for electrical uses due to its unusual strength, resistance to stress-corrosion, good conductivity.

Aluminum fasteners afford light weight as well as excellent conductivity. Anodized, they provide various colors; better corrosion resistance.

Widely used for fasteners, the 18-8 grade stainless steel assures good strength and excellent corrosion resistance in most atmospheres.

How Tensilock® Screws clamp tight, lock tight


Teeth of Tensilock fasteners are shaped to avoid excessive friction in tightening yet resist back-off when screw or nut is fully seated.
This bearing face allows the on-torque effort to develop a high thread tension.

TENSILOCK screws belong in the same league as high strength hex screws. With the same on-torque effort, the Tensilock units develop about 90% of the thread tension usually developed by the latter. Thus, they *both* make strong joints.

THREAD TENSION = CLAMPING FORCE

In theory, the higher the thread tension, the stronger the joint and the higher the inherent ability of the fastener to stay tight. In practice, you derive these benefits by torquing a high strength screw close to its *yield strength*. But what if you need high thread tension plus *extra* assurance that joints will stay tight? Then you have a job for Tensilock units. Not only do they develop the high thread tension, but also have an extra (and *integral*) locking device.

Screw Diameter		¼	⅜	½
Thread Tension (lbs.)	Tensilock	2,750	6,750	12,400
	High Strength Hex	2,975	7,250	13,300
On Torque (inch lbs.)	Both	120	420	1,000
Off Torque (inch lbs.)	Tensilock	150	525	1,250
	High Strength Hex	95	330	800

OFF-TORQUE = LOCKING POWER

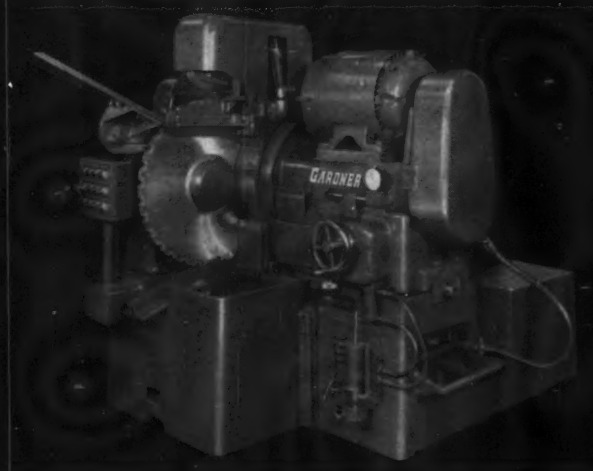
By design, loosening torque of Tensilock fasteners exceeds tightening torque by 25% or more. This is an effective "lock." It gives that extra margin of safety against vibratory loosening.

To sum up: RB&W's Tensilock screws are stronger than Low Carbon Hex Screws; compare with High Strength Hex Screws in clamping force; are superior to them in locking action. Suggestion: For a strong locking *bolt*, use with Tensilock Nut. Send for Bulletin TL-2. Russell, Burdsall & Ward Bolt and Nut Company, Port Chester, N. Y.

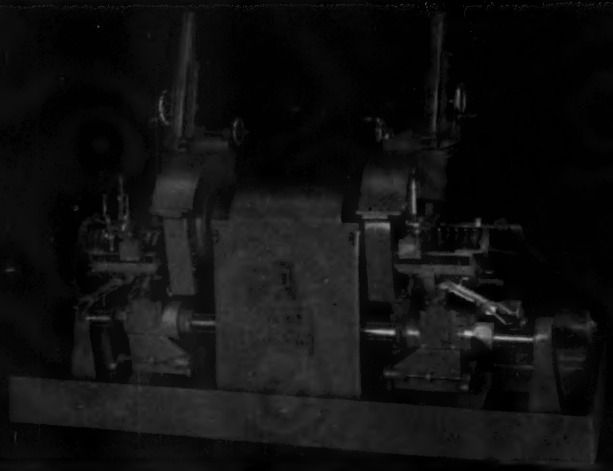
Plants at: Port Chester, N. Y.; Coraopolis, Pa.; Rock Falls, Ill.; Los Angeles, Calif. Sales office and warehouse at: San Francisco, Calif. Additional sales offices at: Ardmore (Phila.), Pa.; Pittsburgh; Detroit; Chicago; Dallas.

from the world's most complete line of disc grinders:

standard and specially engineered machines for a wide variety of disc grinding jobs

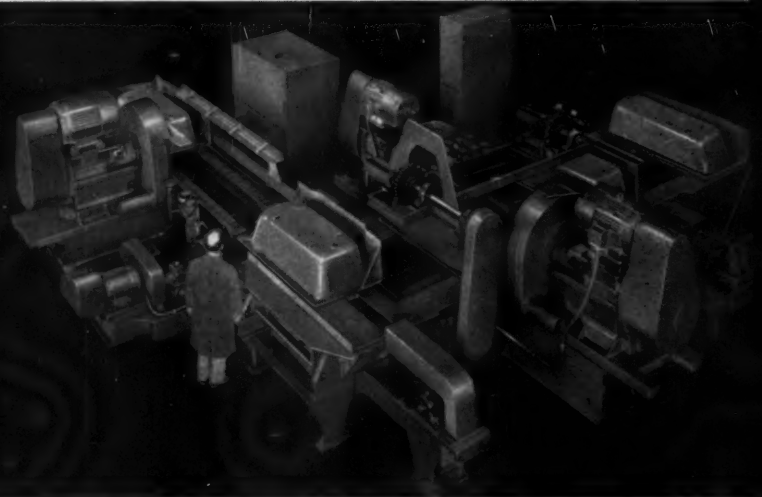


Consistently close tolerances, high rate of production on precision double spindle disc grinders. Five sizes available.



Single spindle disc grinders for production grinding single surfaces. Manual and power operated work-carrying fixtures available.

Grind small precision parts at high production on this vertical double spindle disc grinder which grinds two surfaces parallel in one operation.



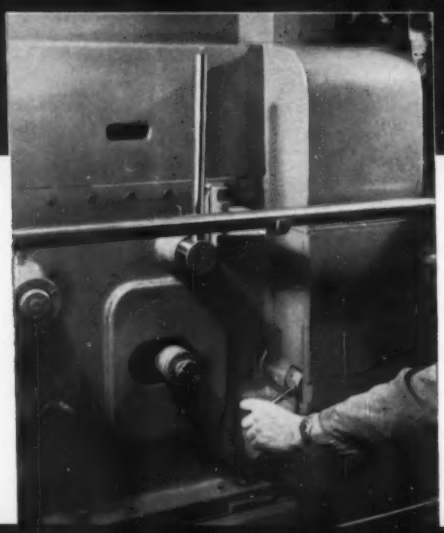
Grind unusual workpieces—like bathtubs—on Gardner Special Purpose Grinders which grind surfaces parallel, generate curved surfaces, single or multiple surfaces.

GARDNER

precision disc grinders

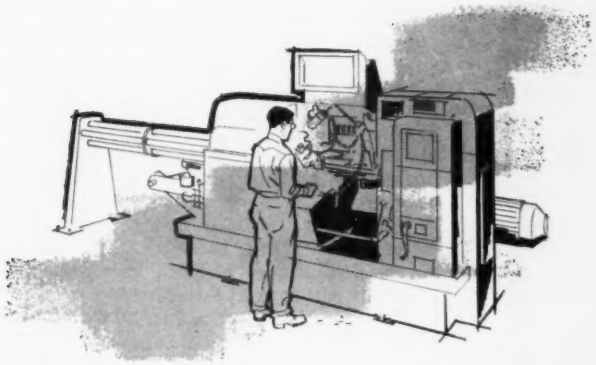
GARDNER MACHINE COMPANY, BELOIT, WISCONSIN

a subsidiary of Landis Tool Company



These Multi-Spindle Automatics set up just like a turret lathe. Spindle drum index is disengaged by lever as shown. Trial cuts made during setup can then be fed on and off the work without going through the entire cycle.

AT THE TROY MANUFACTURING CO.
Burton, Ohio



Job shop holds .001" tolerances on 500-piece lots with Multi-Spindle Bar Automatics

Standard tools and fast setup of Warner & Swasey Automatics overcome unexpected problems presented by wide variety of customer's parts.

Troy Manufacturing is a small 6-man Job Shop specializing in quality contract work. Manager Edward Cseplo says: "We have no product of our own. Our profit must be made on a variety of someone else's parts." This often means tolerances down to .001" in tough work materials, and in quantities ranging between 500 and 5000 pieces. The unexpected problems encountered with a constantly changing type of job places a high premium on machine flexibility and ease of tooling.

After installing *two* Warner & Swasey Multi-Spindle Automatics, Troy easily handles complex, accurate work in small lots from all types of work materials. They seldom scrap a piece, and have little difficulty training new operators on the job.

Mr. Cseplo especially likes the spindle drum index disengaging mechanism for simplifying setups. Also, the ease of tooling with simple standard tools, and the ability of the equipment to form in hard steels. Mr. Cseplo makes no bones about the fact that these Warner & Swasey Automatics are the foundation of his business, and permit him to compete successfully in the highly competitive jobbing business.

Your Warner & Swasey Field Engineer can show you the profitability of Warner & Swasey Automatics for your shop. Warner & Swasey Company, Cleveland 3, Ohio.

YOU CAN TURN IT BETTER, FASTER,
FOR LESS...WITH A WARNER & SWASEY

WARNER & SWASEY

For more data circle this page number on card at back of book

Sectionized Transfer-matic Introduces New Concepts of Processing 4-Cylinder Blocks

A significant forward step in automation has been achieved by a new Cross Transfer-matic which integrates all operations except broaching that are required to finish cylinder blocks of three different horsepower capacities. The multiplicity of operations in a single machine and the fact that the entire line was created by one builder result in large reductions in engineering, materials handling, control circuitry and floor space.

The new Transfer-matic consists of six sections with a total of 121 stations. Three banking conveyors are provided between appropriate sections.

In Sections I and II, most of the heavy metal removing operations are handled. These include straddle milling the main bearings, milling the oil slinger grooves, rough drilling the valve lifter holes, rough boring the cylinders, rough boring the camshaft and milling the ends of the block.

In Section III, the sides are completely machined and the accessory and engine mounting pads are milled.

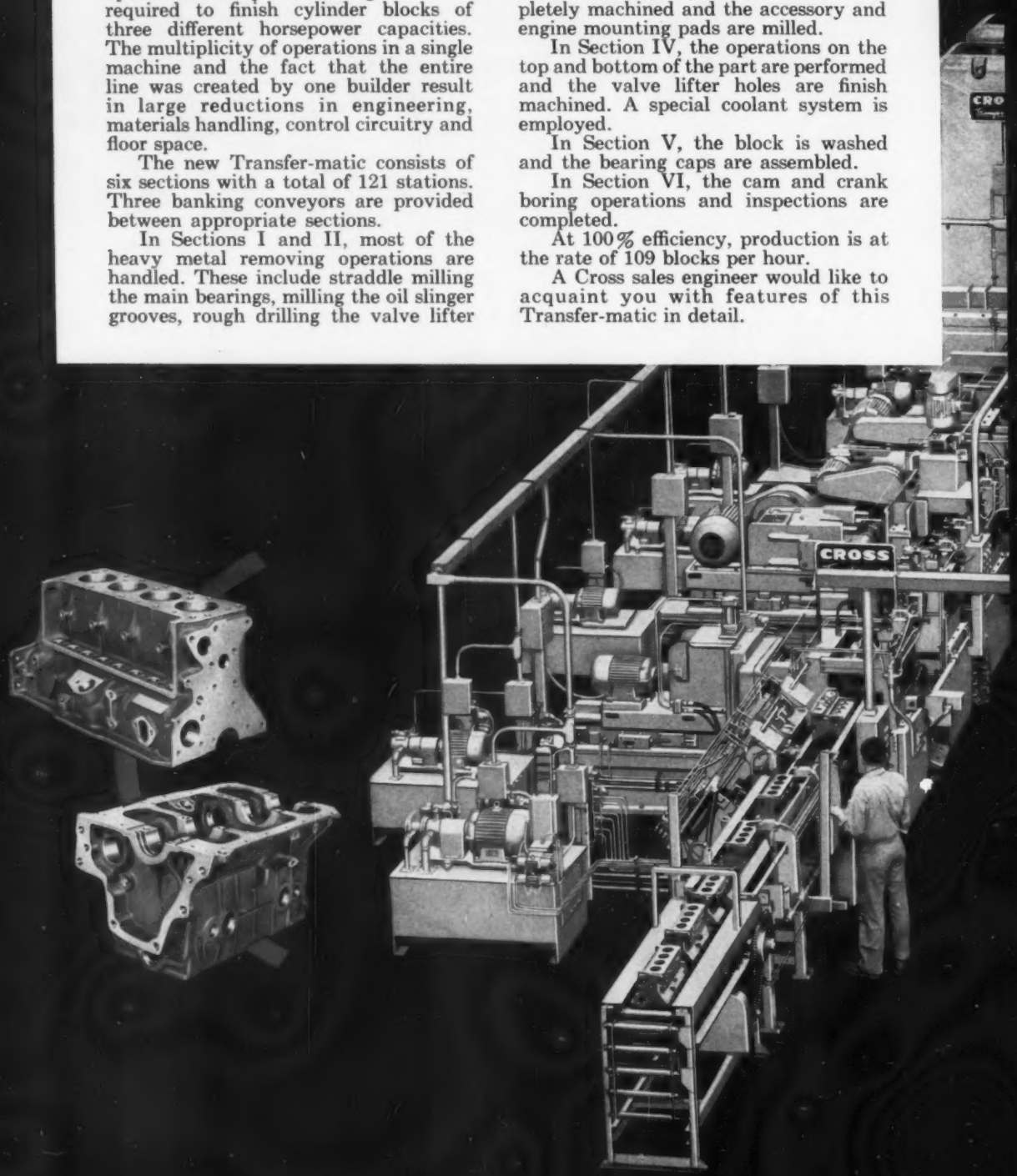
In Section IV, the operations on the top and bottom of the part are performed and the valve lifter holes are finish machined. A special coolant system is employed.

In Section V, the block is washed and the bearing caps are assembled.

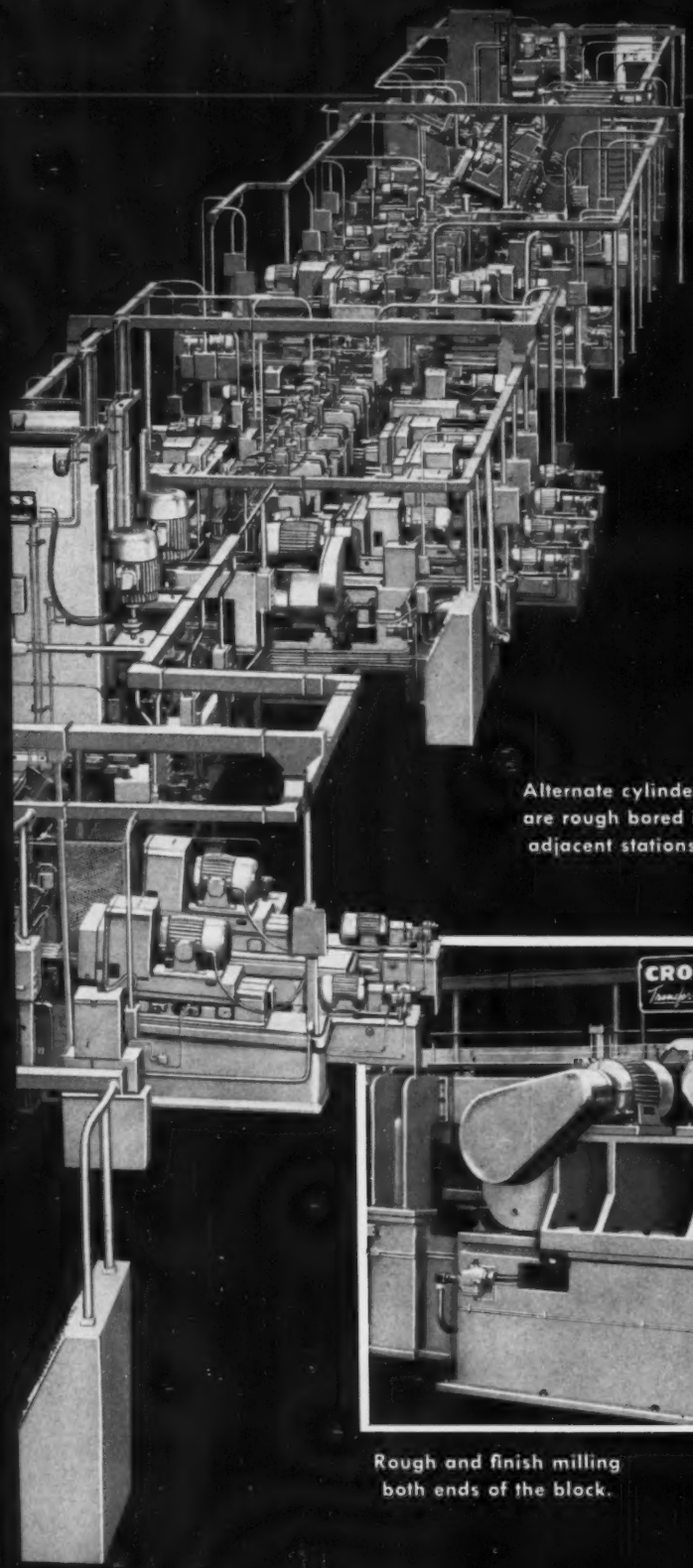
In Section VI, the cam and crank boring operations and inspections are completed.

At 100% efficiency, production is at the rate of 109 blocks per hour.

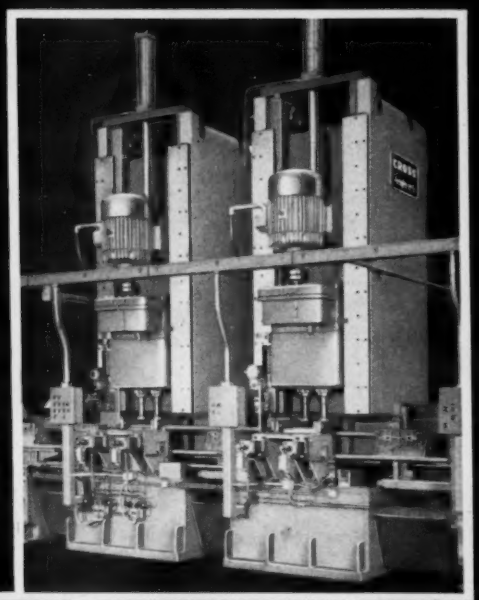
A Cross sales engineer would like to acquaint you with features of this Transfer-matic in detail.

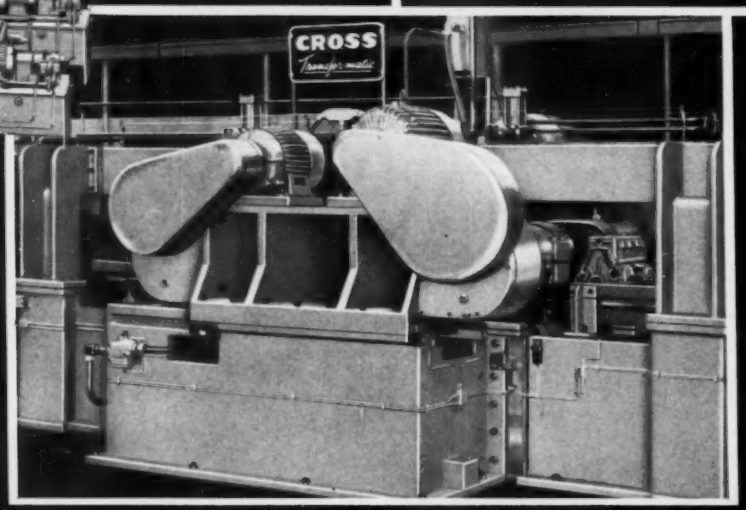


Another Transfer-matic by Cross



Alternate cylinders are rough bored in adjacent stations.





Rough and finish milling both ends of the block.

Established 1898

THE CROSS CO.

First in Automation

PARK GROVE STATION • DETROIT 5, MICHIGAN

to make your short runs practical and profitable buy the new cost cutting

GRAY

equipped with space-setter readout numerical control

time saving: The Gray Space-Setter system readout provides a basic and infallible counting or measuring system. The zero offset feature establishes zero readout at any pre-determined reference point on the workpiece. Operator can read drawing dimensions on panel.

greater accuracy: The Space-Setter system allows accuracies to within .001". It is unaffected by line voltage. The precision construction of the Gray horizontal bar takes full advantage of the Space-Setter system.

fast change-over: More effective machine tool productivity is possible through elimination of costly tooling, thus providing opportunities to be found in previously unprofitable or complex work.

profitable: To hold costs in line on short runs while maintaining the highest degree of accuracy, GRAY horizontal boring, drilling and milling machine is the greatest money maker in the field, proving that Quality doesn't cost — it pays.

The G. A. Gray Co / Cincinnati / Ohio

horizontal milling and boring machines
planers
planer type milling machines

The Job:
machining ball mill
made by
Brighton Corp., Cincinnati.

GRAY
GRAY
GRAY

WANT TO SPEED FORMING OPERATIONS?

You specify the shapes...

ERIE WILL BUILD THE PRESS

When you have unusually shaped parts to position for assembling, forming, forcing, straightening and similar operations, an Erie C-frame hydraulic press may be the all-purpose machine you need. Open on three sides, the C-frame design provides maximum accessibility to the work area. It eliminates the restrictive caging normally caused by support rods or frame castings.

Custom-designed Erie C-frame hydraulic presses can be manufactured to meet unusual requirements. Both horizontal and vertical frame machines have been built for high-speed production in capacities to 500 tons.

Standard Erie C-frame hydraulic presses are also available in a range of sizes, with capacities up to 250 tons.

Erie C-frame hydraulic presses have all steel welded frames to assure a high safety factor with minimum deflection. Power units are built in. Sensitive controls include dual hand and foot levers to provide accurate operation in either direction.

For the complete story, phone or write Mr. Carl Hammon, Erie Foundry Company, Erie 1, Pa. Ask for Bulletin 370.

ERIE

ERIE FOUNDRY COMPANY

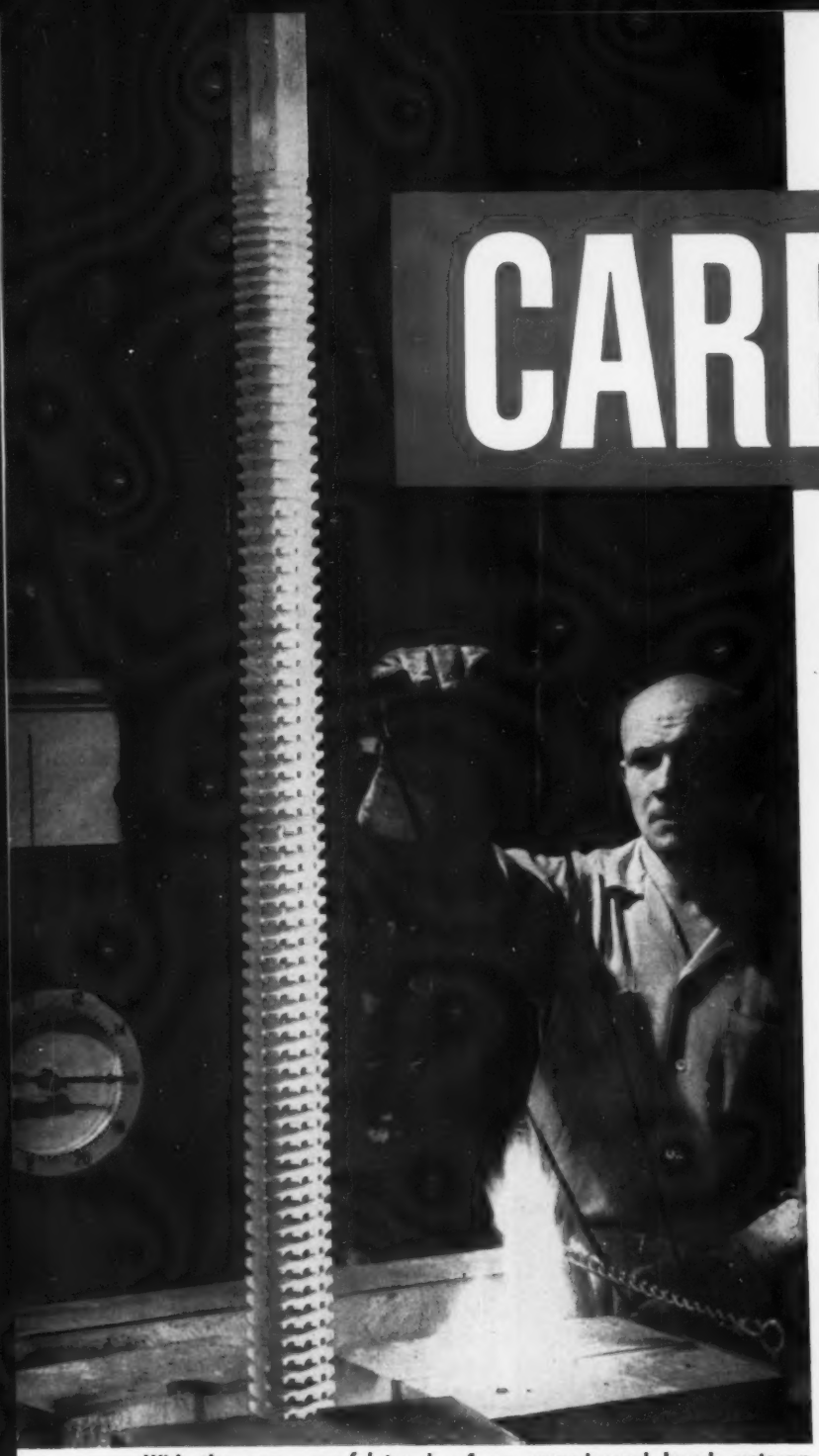
ONE OF THE GREAT NAMES IN FORGING SINCE 1895

EF-60-04

Manufacturers of Forging Hammers • Forging Presses • Hydraulic Presses • Trimming Presses

J-8083

CAREFUL!



With the sure, *careful* touch of an experienced hand, veteran CTW heat-treat man hoists 72" broach from a vertical furnace.

Care in the creation of Continental Broaches takes precision manufacturing a step beyond the exactness of quality control. Thirty years of broachmaking—designing and producing thousands of standard and custom-made broaches—assures *unmatched* efficiency and performance from CTW Broaches.

Find out how Continental's experience in broach engineering, modern heat treat methods and cost-saving production processes can cut down-time and increase output in your operation. Call your local Ex-Cell-O representative, or contact Ex-Cell-O Detroit; in Canada, Colonial Tool Co., Ltd., Windsor.

59-14

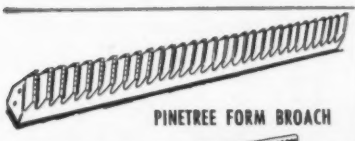
CTW

Continental TOOL WORKS

DIVISION OF

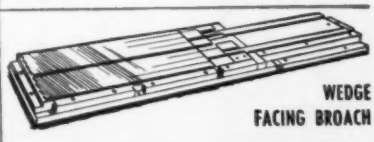
EX-CELL-O CORPORATION

DETROIT 32, MICHIGAN

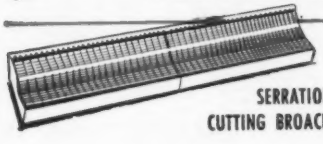


PINETREE FORM BROACH

SPIRAL SPLINE BROACH



WEDGE FACING BROACH



SERRATION CUTTING BROACH

INVOLUTE SPLINE SHELL-TYPE BROACH

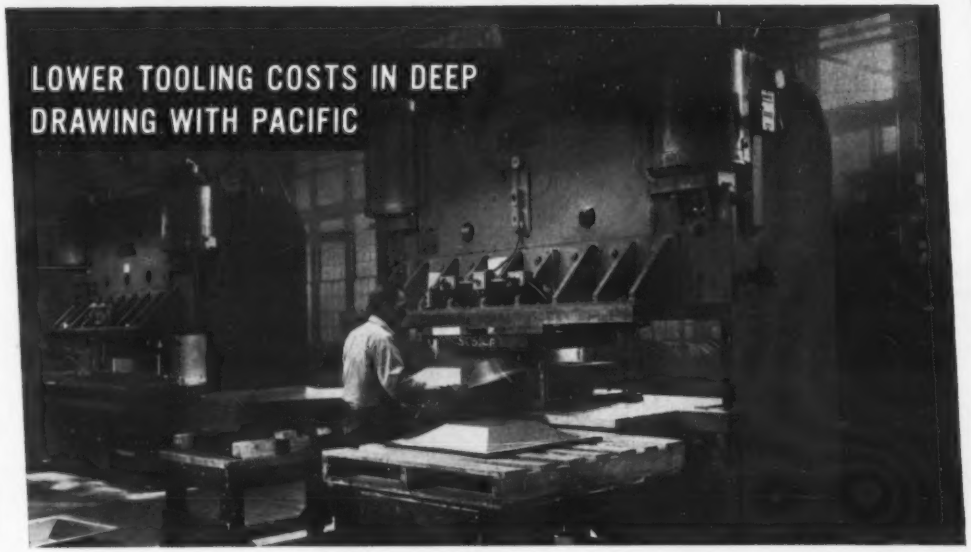
CARBIDE-TIPPED BROACH SECTIONS

For more data circle this page number on card at back of book

15 years engineering and millions of dollars invested* to perfect the world's finest brake... today's PACIFIC HYDRAULIC PRESS BRAKE

Over 9 out of every 10 hydraulic press brakes in operation today are PACIFIC providing...

- More dependability
- Freedom of maintenance and leakage
- Simpler electric controls
- Simpler hydraulic control
- More accuracy in level control
- More accuracy in air bending
- More operating convenience
- Greater visability
- More rigidity in cylinder construction
- Shock-free hydraulic system suitable for punching



Pacific brakes set up for deep drawing now enable the Anemostat Corporation of America, Hartford, Conn., to produce its own air diffuser cones. With limited production requirements that would not justify the expensive tooling required for conventional draw presses, Anemostat can produce these heating, cooling and air conditioning parts in its own plant on two Pacific hydraulic press brakes at appreciable savings and with greater flexibility in production scheduling. Material is mainly 20 and 22 gauge cold rolled steel. Blanks range from 12" square to 42" square with draws from 4" to 6" deep. The brakes have been operating continuously for over a year with no downtime and virtually no maintenance.

*THIS INVESTMENT ENABLED PACIFIC TO INTRODUCE:

- Tape control to synchronize cylinders within .003" (1947)
- Cushioned punching (1949)
- Precision depth control to repeat accuracy within .001" (1951)
- Manual turret stroke controls for progressive bending (1952)
- Selective anti-whip speeds to eliminate reverse bends (1952)
- Tandem operation of press brakes for forming pieces 40 ft. or longer (1953)
- Tonnage control to protect light dies in heavy press (1953)
- Multiple hydraulic cushion cylinders for deep drawing (1954)
- Overhead integral power unit for increased accuracy (1955)
- Cylinder ram guides for increased rigidity (1956)
- Shearing attachment for shearing heavy plate on press brake (1958)
- Pipeless stacking of valves to eliminate pipe breakage and leakage (1959)
- Shockless hydraulic valving to eliminate cause of leakage (1959)

PACIFIC PRESSES AND SHEARS

PACIFIC INDUSTRIAL MFG. CO., OAKLAND, CALIF. • PACIFIC PRESS AND SHEAR CORP., MT. CARMEL, ILL.

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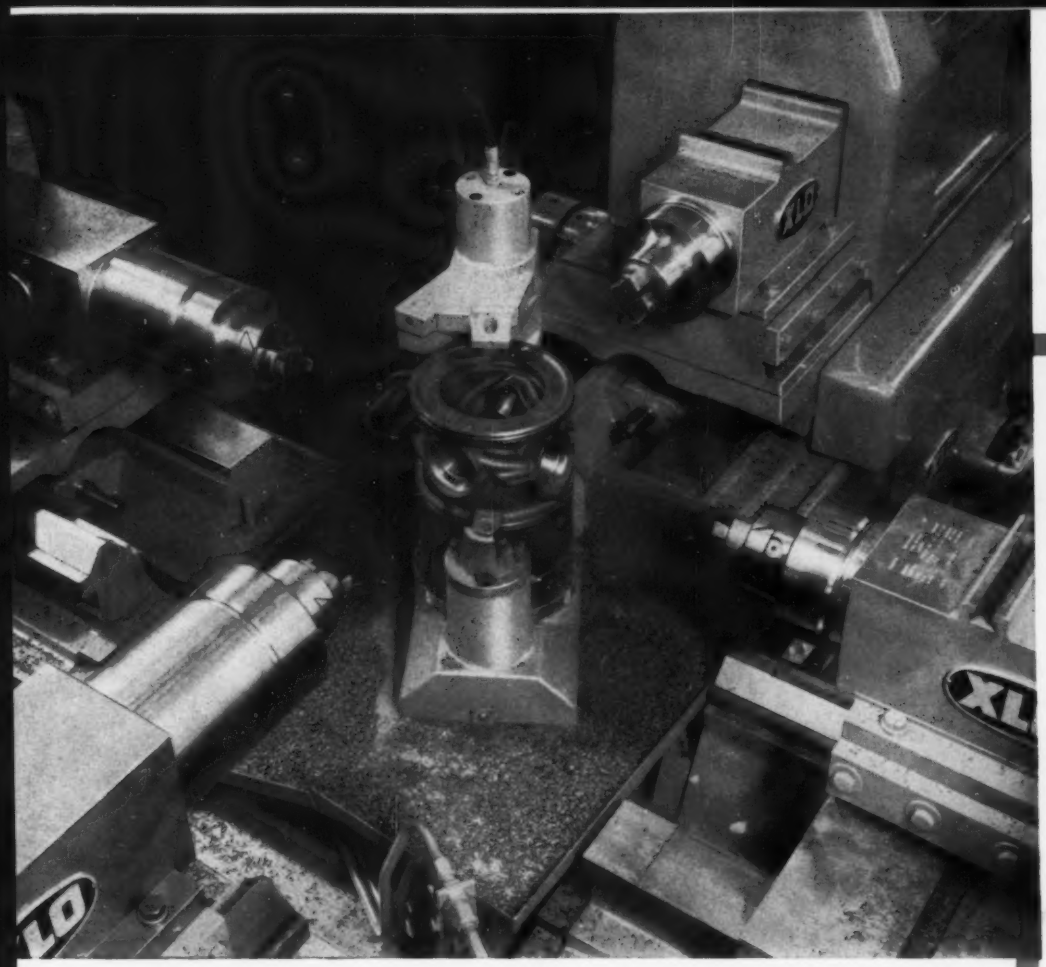
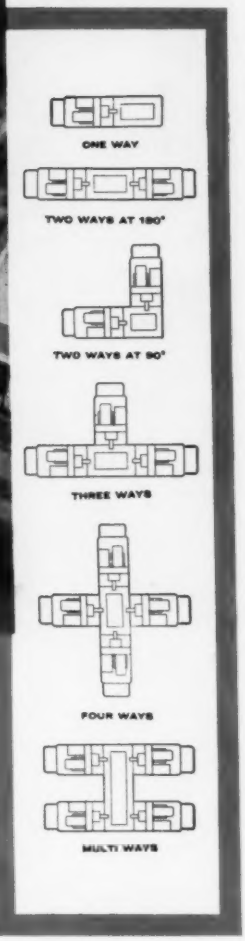


TYPICAL "BUILDING BLOCK" ARRANGEMENT



4-Way Production Savings with Ex-Cell-O Way Machines

1 **LOWER COST** Each Ex-Cell-O "Building Block" Way Machine Unit has standard base, table slide and complete, inbuilt hydraulic system. You can specify only the standard spindles or accessories that meet your present needs. 2 **INCREASED FLEXIBILITY** One Way-type unit gives you a basic, versatile precision boring machine; as operations become more complex, simply add one or more Way units to a common end section to multiply production or machining functions. 3 **MORE VERSATILITY** Ex-Cell-O Way Machines permit precision boring, turning, facing or grooving, chamfering or counterboring—with or without automatic cycles, work indexing or clamping. 4 **GREATER CAPACITY** Using simple fixtures, you can rough or finish-machine larger, heavier work than possible on most standard boring machines.

Ask your Ex-Cell-O Representative about savings with Way-type Machines, or write direct for details.

Typical setup shows four units positioned at 90° for simultaneous rough boring, counterboring and trepanning. Beds, tables, center section, hydraulic systems, controls and Ex-Cell-O Precision Spindles are standard components. Units can be rearranged at any time.

60-29

EX-CELL-O FOR PRECISION

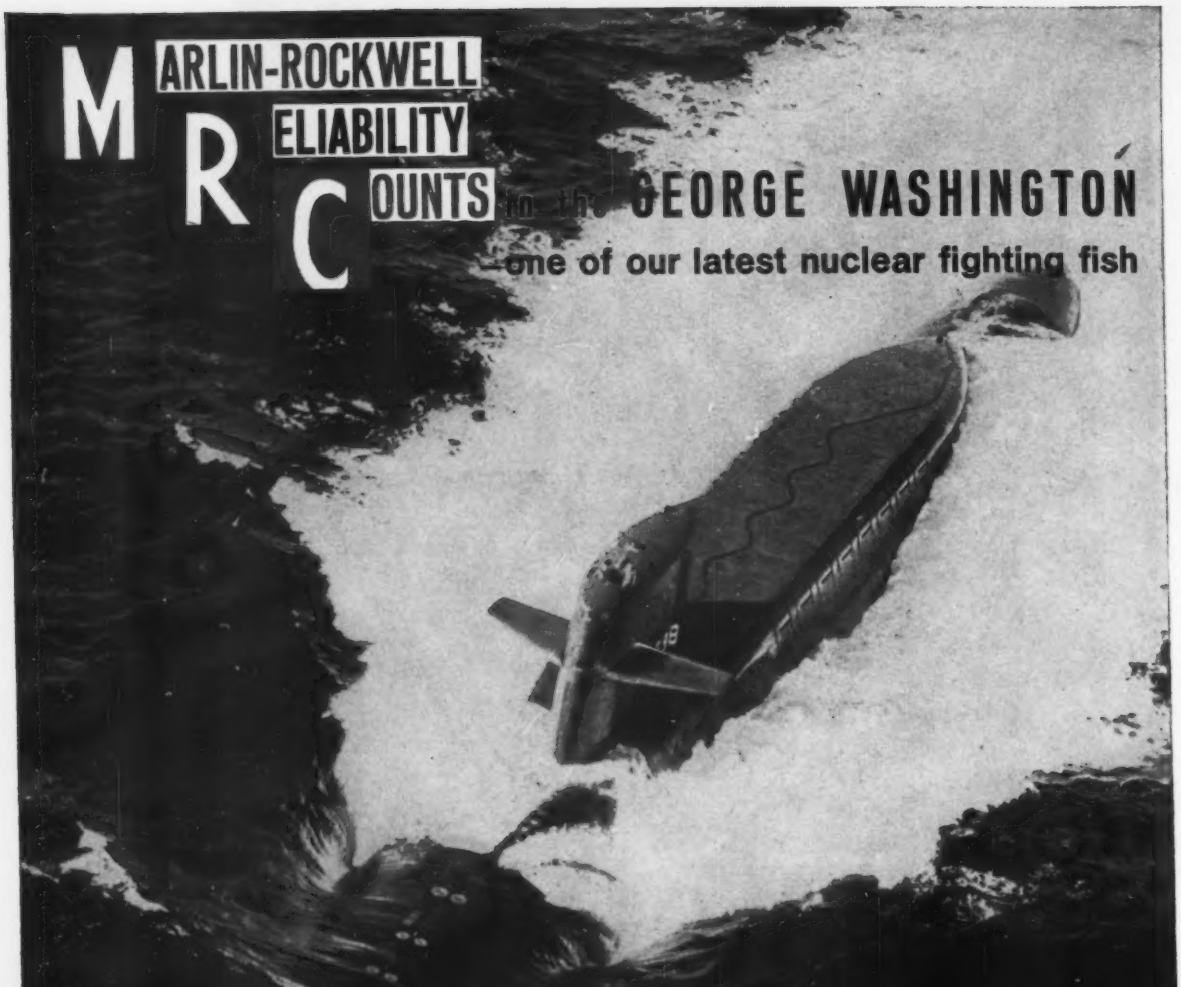
PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • JIG AND FIXTURE COMPONENTS • TORQUE ACTUATORS • CONTOUR PROJECTORS GAGES AND GAGING EQUIPMENT • GRANITE SURFACE PLATES • COMPUTER PRODUCTS • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • ATOMIC ENERGY EQUIPMENT • DAIRY AND OTHER PACKAGING EQUIPMENT

Machinery Division

EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN

MARLIN-ROCKWELL RELIABILITY COUNTS in the GEORGE WASHINGTON

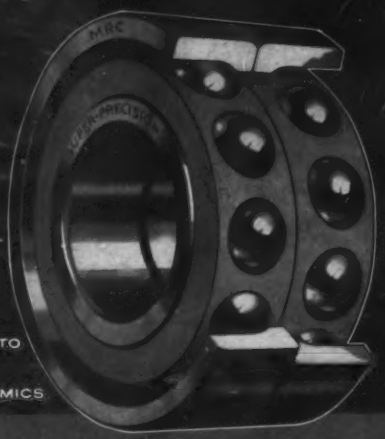
one of our latest nuclear fighting fish



MRC Engineers, working with the country's leading electric motor manufacturers, have developed the world's quietest, smoothest running and vibration-free bearings for use in the electric motors of our nuclear powered submarines.

While most applications do not require bearings with such extremely close tolerances, the techniques developed to produce these highly successful bearings are employed in manufacturing other bearings to tolerance levels commensurate with the equipment in which they are to be used.

These achievements have contributed greatly to the general overall performance expectations of all types of bearings for any critical applications.



OFFICIAL U. S. NAVY PHOTO

ship built by GENERAL DYNAMICS

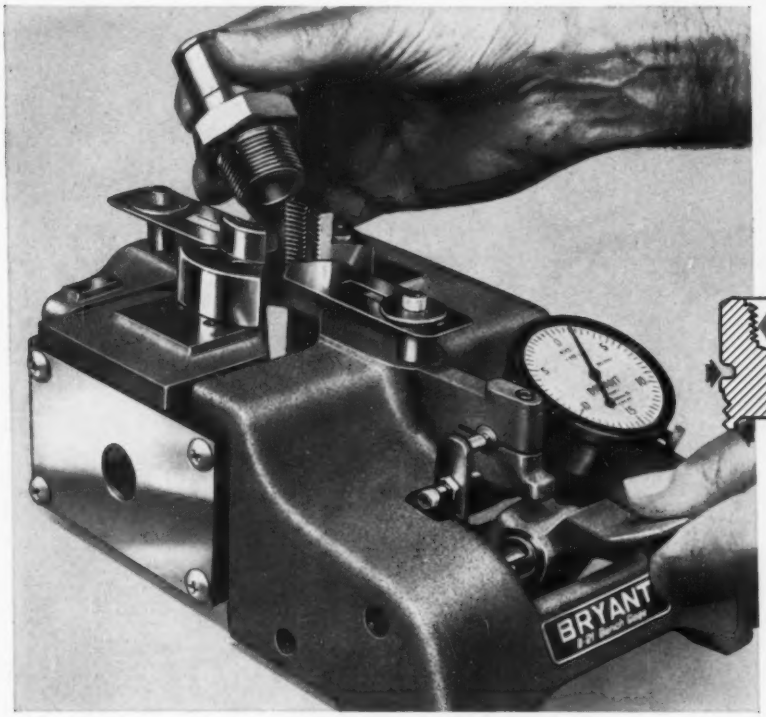
Consult OUR Engineering Department on YOUR Bearing Problems

MRC BALL AND ROLLER *bearings*

MARLIN-ROCKWELL CORPORATION

Executive Offices: Jamestown, N.Y.

All these checks . . . with one Bryant Gage!



CHECKS THREADS, GROOVES AND BORES—Bryant B-21 Bench Gage checks parts with special grooves, snap-ring or O-ring grooves, or ID and OD threads in all classes to 5″ diameter—and does it 8 to 10 times faster than other methods! Stationary and movable gaging segments end the need to thread parts onto gage.

CHECKS SQUARENESS-OF-FACE—With optional Squareness-of-Face Attachment, the B-21 simultaneously checks thread size and true face run-out in relation to thread axis. Two models: One for parts up to 2″ face diameter, one for parts to 7″ face diameter. Attaches in seconds to the B-21 Gage.

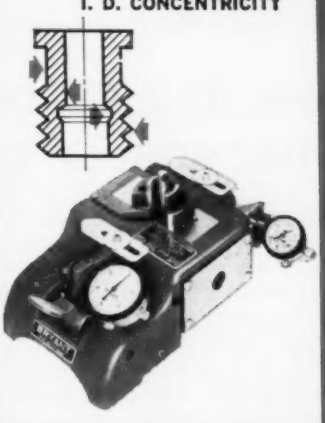
CHECKS ID CONCENTRICITY—Attachment A-9081 quickly converts the B-21 to check concentricity of bores, grooves or special internal recesses in relation to OD threads or plain OD surfaces of parts up to 8″ diameter with up to 5″ nominal thread size.

AND MORE—See your Bryant Gage Representative, or write for prices, engineering data, and bulletins on the standard and special accessories that make the Bryant B-21 Bench Gage indispensable to quality control throughout industry.

STANDARD B-21 GAGE

SQUARENESS-OF-FACE

I. D. CONCENTRICITY



61-42-B

EX-CELL-O FOR PRECISION

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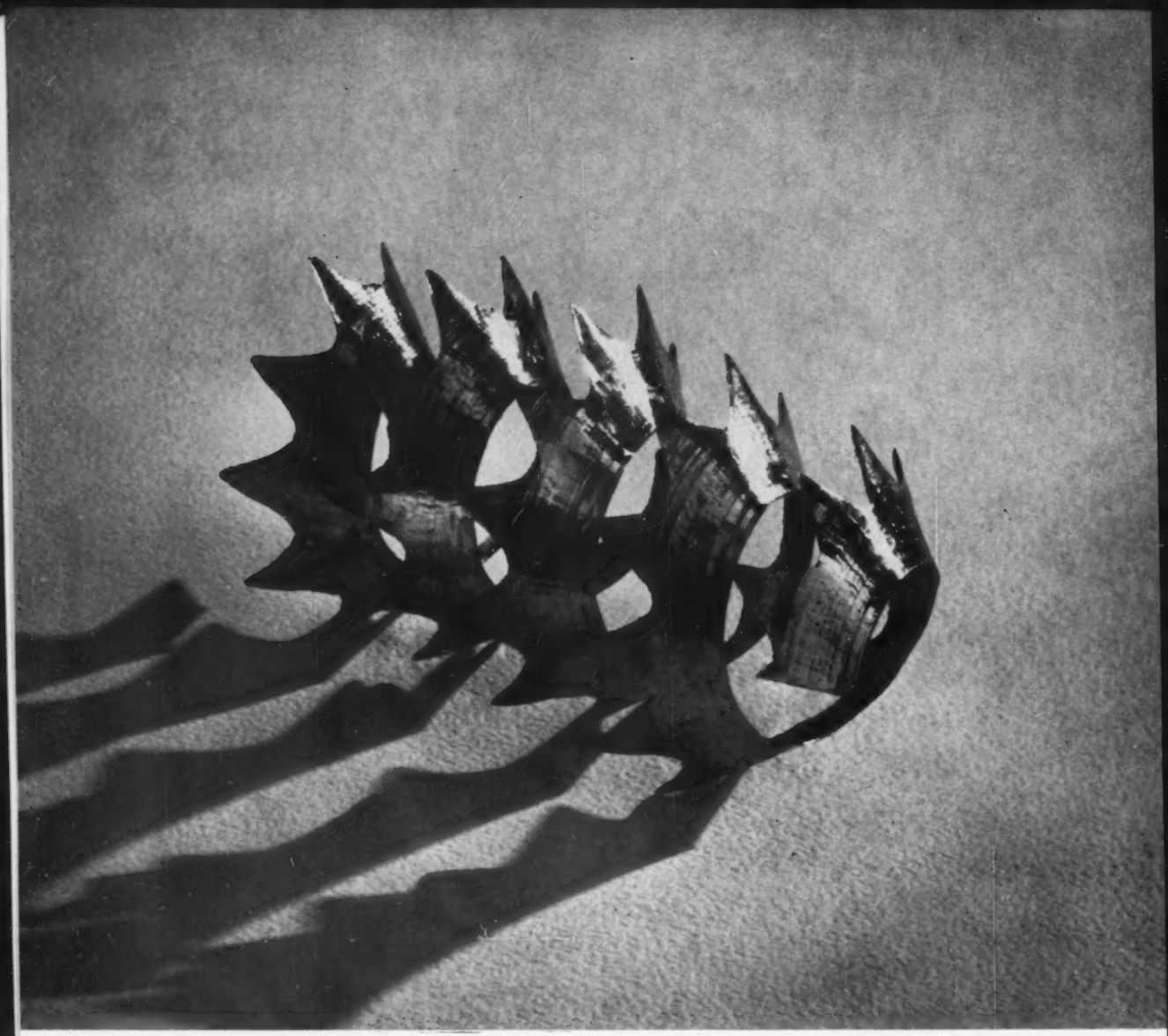
EX-CELL-O CORPORATION

Greenville Plant, 945 E. Sater St., Greenville, Ohio



Chip – magnified 4 times – produced by machining Waspalloy with Rex 49

New Rex 49 outlasts other special purpose high speed steels better than 2 to 1

Rex 49 – a new high speed steel that can machine today's "difficult-to-cut" metals *faster and more economically* than existing special purpose high speed steels – is another in the long line of advances and improvements in specialty steels to come from Crucible research.

Crucible laboratory tests indicate that tools made of Rex 49 last as much as 4 times longer than other special purpose high speed steels . . . and it has a base price ⅓ to ½ of these steels.

Both laboratory and field reports prove the advantages of Rex 49 for machining hard, tough or abrasive metals, such as heat-treated alloy steels, stainless, titanium, and superalloys. These tests also indicate that Rex 49 has advantages in machining the more conventional metals through increased speeds, feeds and depths of cut — and Rex 49 can be hardened with conventional high speed steel heat treating equipment.

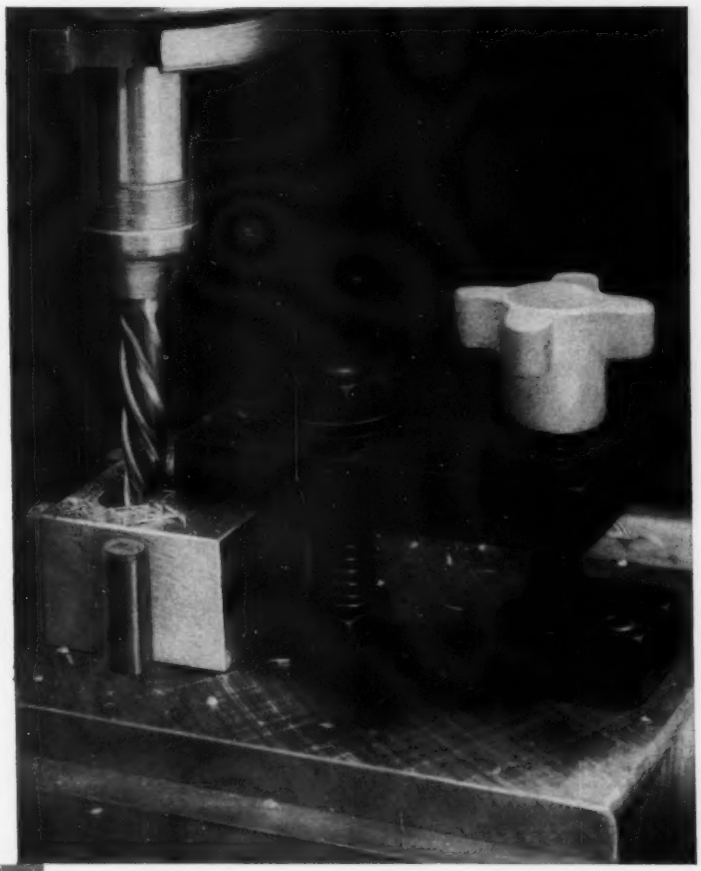
Rex 49 is indicative of Crucible's continuing leadership in the development of improved high speed and tool steels.

For more information, write: *Crucible Steel Company of America, Dept. HD20, Four Gateway Center, P. O. Box 88, Pittsburgh 30, Pa.*

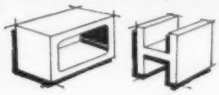
CRUCIBLE STEEL COMPANY OF AMERICA

NOW A Complete line of Jig & Fixture time-savers!

Ex-Cell-O Precision Clamp Assemblies and Standard Details for Fast, Economical Fabrication of Jigs and Fixtures



COMPONENTS FOR ALL YOUR JIG & FIXTURE NEEDS — AVAILABLE IMMEDIATELY FROM A SINGLE, RELIABLE SOURCE!



Micron Sections Machined cast-iron shapes cut to order.

Drill Jig Bushings Carbide or steel for metal and plastic jigs.

Lift-Swing Fixtures For fast drilling of difficult holes.

Reader service card number is for Fixture Components only; please request literature on other items separately.

Ex-Cell-O's new line of clamp assemblies, fixture details, spring plungers, torque screws and other fixture components gives you an unusually wide range of standard clamps and details in sizes and types to suit virtually every fixture-building need.

The complete cataloged line—from clamps and locks to plungers, locating buttons, handwheels and torque screws—is available from your local Ex-Cell-O Representative or Distributor, or direct from Ex-Cell-O. Phone TOwnsend 8-3900; TWX-DE 876; Wire ZTC.

BUYER'S GUIDE and PRICE LIST—Ex-Cell-O's new Fixture Component Catalog lists hundreds of parts and assemblies, specifications and prices. No cost or obligation. Send for it today!

61-20BU

EX-CELL-O FOR PRECISION

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Bushing Sales Division

EX-CELL-O CORPORATION

DETROIT 32, MICHIGAN

2500 ton Verson Crank Press

serves dual purpose for truck and bus builder

For many production requirements, the ability to make major equipment do more than one job can lead to important savings. That's just what a large manufacturer of automobiles, trucks and busses has done with the Verson press shown above.

The press is a big one. Capacity is 2500 tons. It's a double crank machine with front to back cranks. Area of the bolster between columns is 60″ x 276″. The press operates at eight strokes per minute with a twenty inch stroke. The slide is equipped with delayed action pneumatic knock outs, and the bed is equipped with pneumatic die cushions. Floor space required is 124″ x 392″. Height is 310″. Weight exceeds 850,000 pounds.

As shown above the press is tooled to produce the truck and bus frame members shown at the left. When required, tooling can be changed to produce rear axle housings, a completed stack of which can be seen to the right of the press. Three sets of dies are installed for producing the rear axle housings to blank, draw and finish form.

If you're interested in getting the most out of press equipment, go over your requirements with your Verson Representative. He'll be glad to show you how you can take maximum advantage of Verson press building and press application capabilities. If you prefer, send an outline of your needs and we will make specific recommendations.

Verson

Originators and pioneers of allsteel stamping press construction

VERSON ALLSTEEL PRESS CO.

256 **9309 S. Kenwood Avenue, Chicago 19, Illinois • 8300 S. Central Expressway, Dallas, Texas**

MANUFACTURERS OF MECHANICAL AND HYDRAULIC PRESSES AND PRESS BRAKES • TRANSMAT PRESSES • IMPACT MACHINING PRESSES
TOOLING • DIE CUSHIONS • VERSON-WHEELON HYDRAULIC PRESSES • HYDRAULIC SHEARS • PLASTICS MOLDING PRESSES

For more data circle this page number on card at back of book

Using basic components, seven different arrangements are possible, as shown above. Spindle drive motors can be mounted at right, left, or on both sides with single or double spindles; two machines can be placed side-by-side or used with other production machines.

The 4 BIG Features of Ex-Cell-O's New 411 Vertical Are Important To You

1. QUICK TOOL CHANGING—Tool changing and adjusting is fast and easy because of "clean" design and placement of the Model 411's components.

2. EASY PARTS HANDLING—Vertical construction lends itself to safe, easy loading and unloading of parts in a wide variety of shapes and sizes.

3. SINGLE COLUMN CONSTRUCTION—Solid base-column gives firm support to the hydraulically-operated compound tool slide. Rugged, simple construction assures maximum accuracy and efficiency, plus long life with lowest maintenance.

4. PRODUCTION VERSATILITY-The all-new Model 411 performs turning, boring, facing, grooving, limited contouring and chamfering operations singly or in combination. Often, both sides of disc-type parts can be machined simultaneously.

Contact your Ex-Cell-O Representative or write direct for details.

61-60M

EX-CELL-O FOR PRECISION

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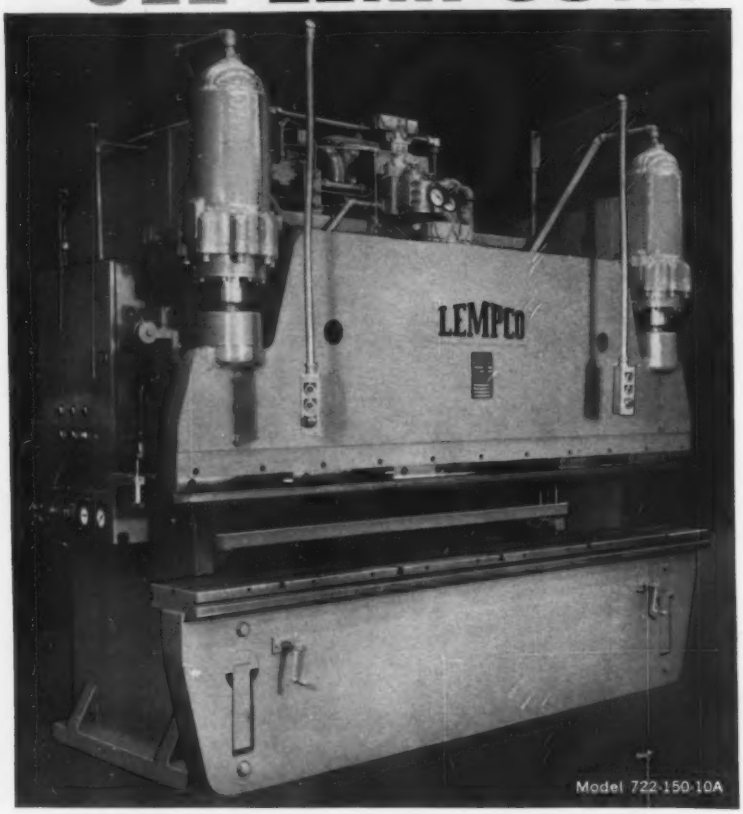
Machinery Division

EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN

SEE LEMPCO...



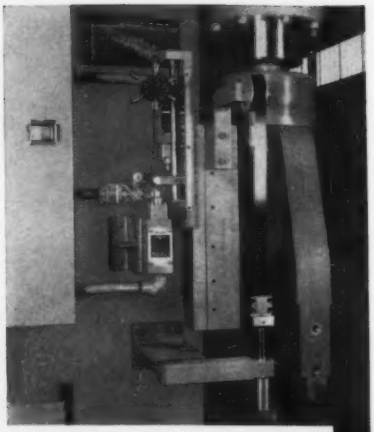
A Lempco hydraulic press brake is a production man's machine tool. Simple, rugged and accurate. Designed to put and hold the profit factor in the general run of shop work.

Offered in standard models of 75 tons capacity and upward, Series 722 hydraulic brakes are powered by the exclusive Lempco equalizing drive. No destructive shock surges, no fussy electronics. Just a good smooth and simple power drive with manifolded valving and a minimum of component parts. Frames are heavy rolled steel plate, sized to a standard of minimal deflection.

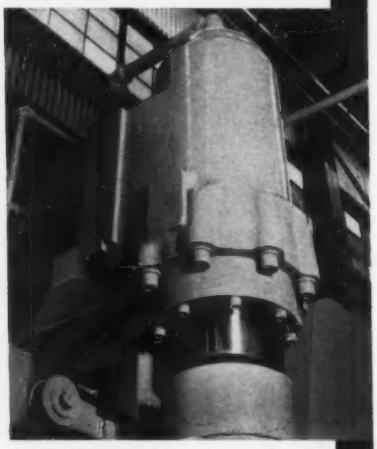
A wide line of standard and optional control features enables you to put the precision into your work that good commercial practice requires.

For more information call your local Lempco Machine Tool Division representative, or get in touch directly with the factory.

LEMPCO
MACHINE TOOL DIVISION
BEDFORD, OHIO



Stroke controls offer micrometer-precise depth stopping, adjustable limiting of ram return and slow-down to press.

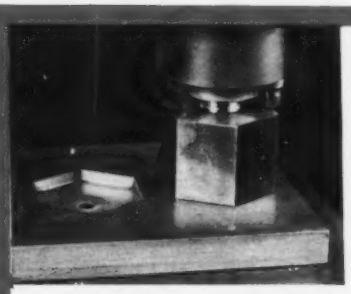


Cast steel cylinders are dovetailed to the housings to hold accurate alignment under load.

Accurate, adjustable ram ways have bronze liners sliding smoothly against gibs bolted to the housings.

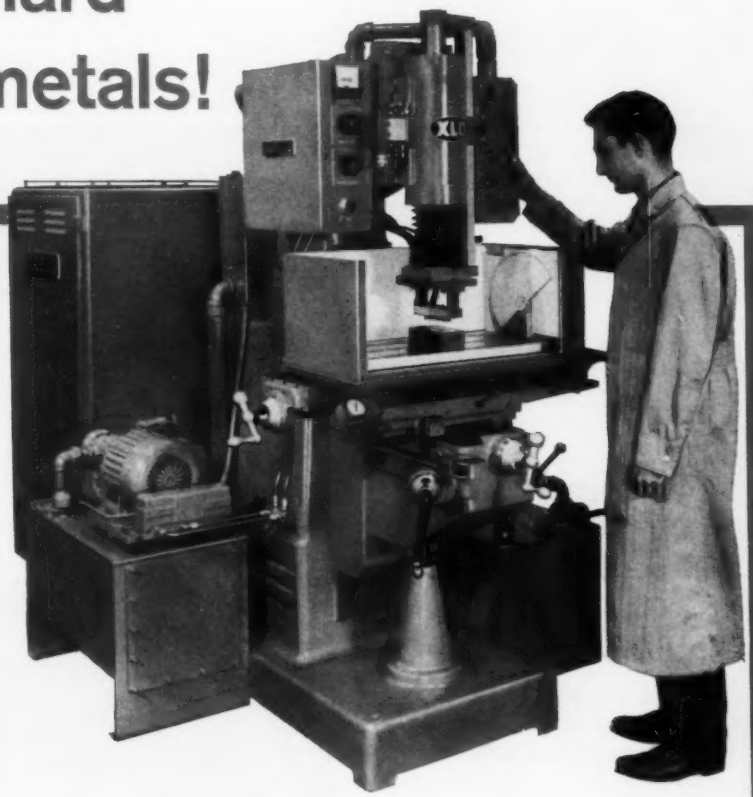
..."engineered-for-the-customer" products from the Lempco family of industrial equipment

LECTRA-FORM...The easy, low-cost way to cut hard and tough metals!



Lectra-Form produces an accurate, inverse image of the tool with a fine, uniform matte-type finish.

This wrench die was machined by Model 244 shown at right. Removable front panel of dielectric tank simplifies loading.



If the material you're working conducts electricity . . . you can drill, pierce, trepan, slot or cut it, or sink intricate die cavities in it with LECTRA-FORM, the all-new Ex-Cell-O Vertical Electrospark Machine!

Using low-cost, conductive sheetmetal, rods or tubing for tooling, LECTRA-FORM produces an inverse image of the tool, or electrode, through high-current, low-voltage electrical spark discharge. There is no tool pressure, no heat.

Standard Model 244 features include four-way slide positioning and vertical knee movement, automatic tool feed and gap distance control, front-load work tank, plus graduated dials for work positioning, a power supply cabinet and dielectric fluid storage tank.

Contact your Ex-Cell-O Representative, or write direct for complete details.

60-79

EX-CELL-O FOR PRECISION

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Machinery Division

EX-CELL-O CORPORATION

DETROIT 32, MICHIGAN

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GIDDINGS & LEWIS

FOR THE COMPLETE

GIDDINGS & LEWIS

. . . first in machine tools specifically designed and manufactured for numerical control.

Horizontal boring, milling, and drilling machines — table, floor, and planer types — 3″ to 14″ spindle diameters — positioning or contouring control.

Vertical boring and turning machines — 32″ to 20′ table sizes — positioning or contouring control.

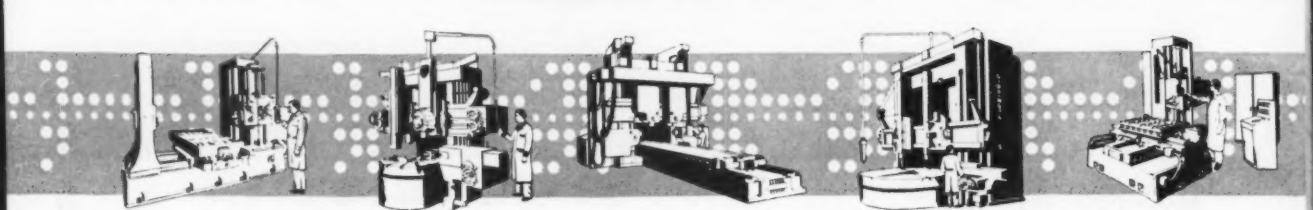
Jig borer and milling machine — combines heavy milling capacity with precision positioning under Numeripoint control.

DiMil and Variax horizontal contour milling machines — 2, 3, 4, and 5-axis — Numeripath controlled.

Planer mills — 36″ to 144″ table widths standard — positioning or contouring control.

Radial and precision drilling machines — with 2-axis Numeripoint control positioning tables — sizes to suit job requirements.

Call your Giddings & Lewis distributor or write for literature.



TAPE CONTROL "PACKAGE"

Machines. A complete new line designed and built to be operated under numerical control — horizontal boring, drilling, and milling machines . . . vertical boring and turning machines . . . combination jig borer-milling machine . . . contour milling and die sinking machines . . . positioning tables . . . planer mills.

Controls. The system of your choice, including Numeripoint* and Numeripath* controls of G&L design and manufacture to give you maximum productivity in point-to-point positioning or path machining, plus guaranteed responsibility vested in a single supplier.

Tape control training. G&L trains your operators when the machine is installed, teaches existing personnel how to program and prepare tapes, provides in-plant instruction of your maintenance men and conducts service training schools at Fond du Lac.

Reference material. Programming and control manuals thoroughly explain the equipment and procedures.

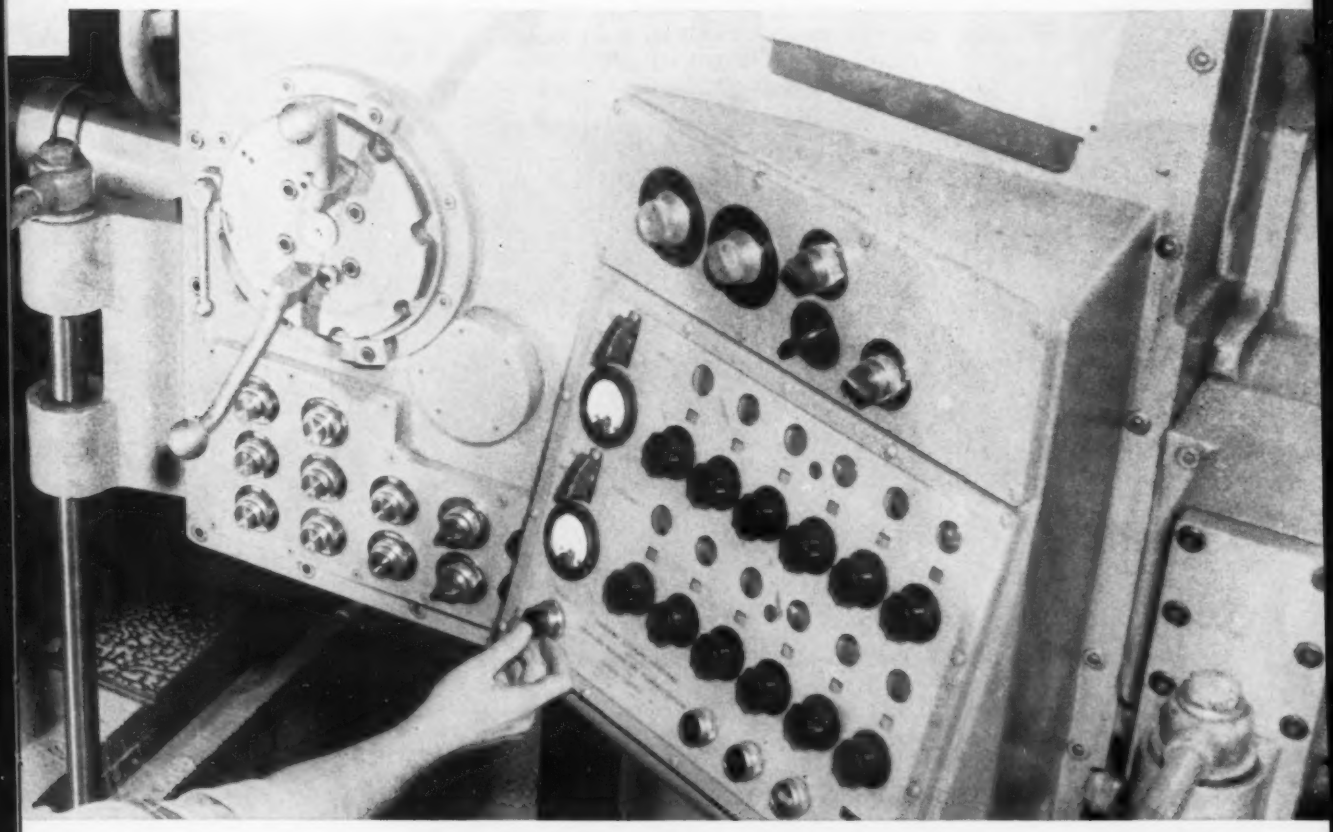
Cutting tools and toolholders. Davis pre-size VBM and VTL tooling . . . boring tools . . . arbors, sleeves . . . continuous-feed facing heads . . . tapholders for machines without thread leads . . . and special tools.

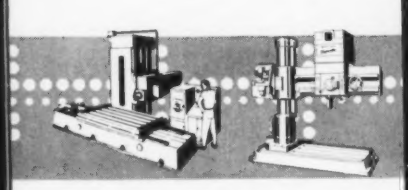
Accessories and attachments. Rotary tables, angular milling attachments, box-type angle plates, V-blocks, stop and jack blocks, measuring devices, and other equipment for speeding setups and production.

Consultation. Giddings & Lewis built the first commercially available tape-controlled machine tool, has shipped more types of major machines with numerical control than any other builder, uses tape control extensively in its own shops. This experience is available to help you justify, select, and apply numerically controlled machines for maximum manufacturing and economic benefits.

Ask for details and literature.

*Giddings & Lewis trademark





GIDDINGS & LEWIS

GIDDINGS & LEWIS

GIDDINGS & LEWIS MACHINE TOOL COMPANY, Fond du Lac, Wisconsin

Jig borer and milling machine; horizontal boring, drilling, and milling machines; vertical turret lathes; vertical boring mills; positioning tables; die sinking machines; contour milling machines; radial and upright drilling machines; planers; planer mills; numerical and tracer control systems; Davis boring tools.

T61-1

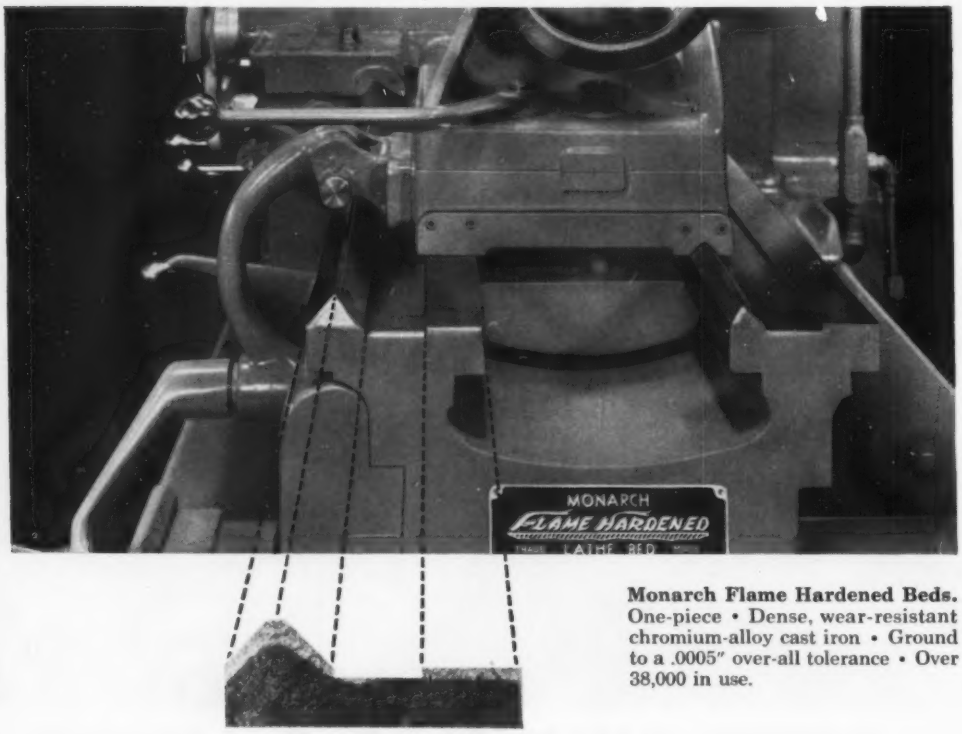
Over 38,000 Monarch Lathe Beds can't be wrong

You never saw this flame hardening procedure until Monarch perfected it. But for many years, it has produced one-piece lathe beds without equal for sustained hard use, with retained original "factory fresh" accuracy.

Unique advantages over nonhomogeneous types of bed construction include: *complete rigidity* — no elastic members which cannot be kept straight; *even thermal expansion* — no uneven bending due to several different coefficients of expansion; *all four bed ways flame hardened* — only when all the ways are hardened is permanent alignment of tailstock and carriage assured. Having ways integral with the bed itself, *vibration damping* is unequaled, the precision ground way surface *accuracy stays put* and *no replacements ever* are required due to way separation from the machine base.

Flame hardening of lathe beds is not an easy-to-come-about nor simple technique. It requires (1) selection of the most ideal material analysis for the job; (2) necessary knowledge and experience with respect to processing and machining for optimum results, and (3) facilities to do the job right.

Monarch applies this process to all models and sizes. Flame hardening is just one of the many examples of where the extra values come from when you use lathes made by THE MONARCH MACHINE TOOL COMPANY, SIDNEY, OHIO.



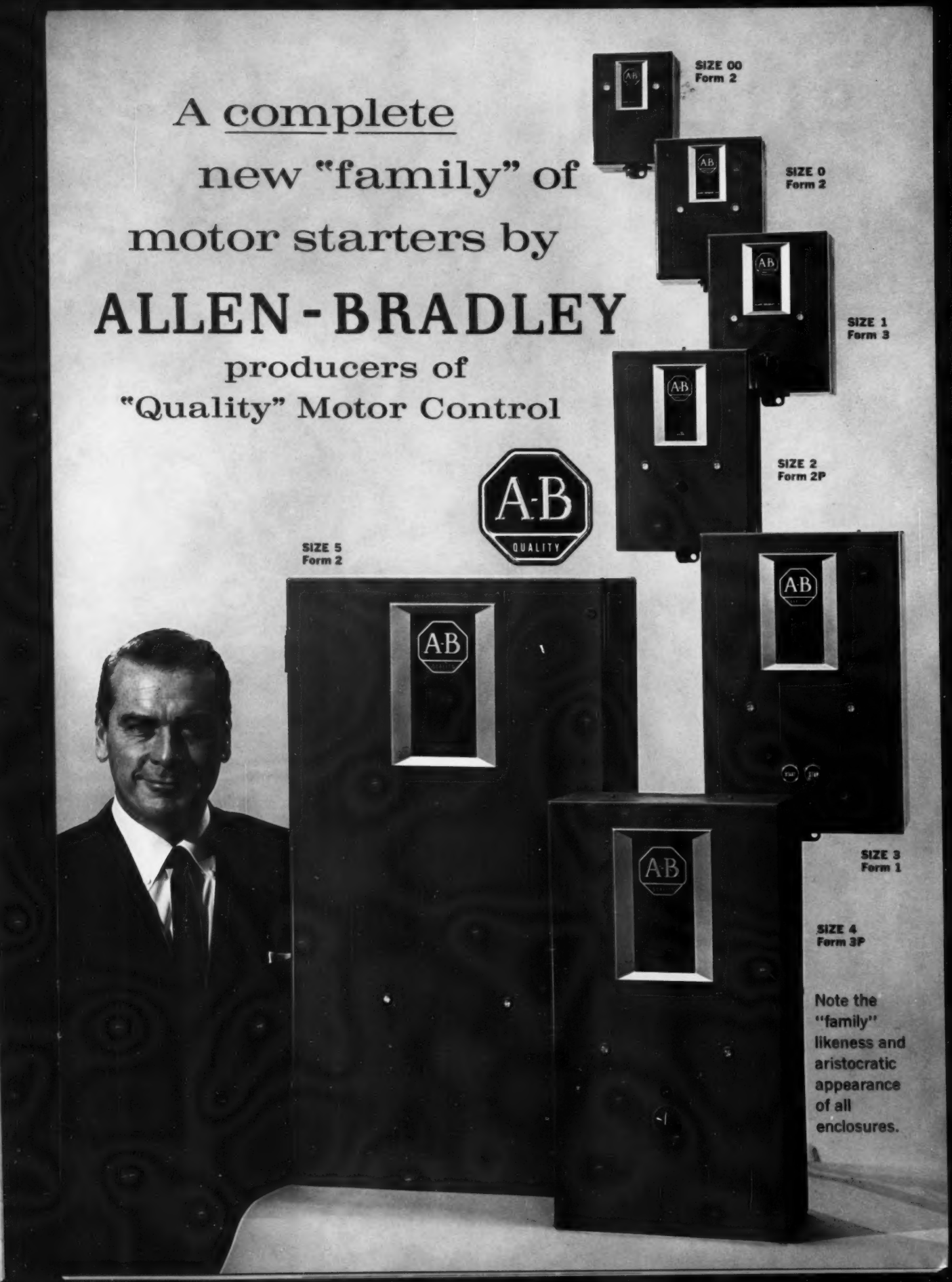
Monarch Flame Hardened Beds. One-piece • Dense, wear-resistant chromium-alloy cast iron • Ground to a .0005" over-all tolerance • Over 38,000 in use.

Monarch
TURNING MACHINES

ASK ABOUT THE MONARCH DEFERRED PAYMENT AND TOOL LEASE PLANS

A complete new "family" of motor starters by ALLEN-BRADLEY

producers of
"Quality" Motor Control



Greatest advance in motor

PLUS VALUES OF THESE NEW STARTERS

- smaller size
- greater interrupting capacity
- even more millions of trouble free operations
- more wiring room
- elegant styling
- A-B "quality" throughout

Thirty years of experience have gone into the design of this new Allen-Bradley line of motor starters. While retaining the principle of the simple solenoid design—with only ONE moving part—everything about these Bulletin 709 starters is **new**.

They're small—especially in the higher ratings. Yet, size for size, all tests have proved that they will outlast any starter now on the market —many times.

The **new**, patented, high-efficiency magnet—remarkably powerful for its weight and size—is cushioned to reduce shock and wear. The **new** coil is encapsulated for mechanical protection, and cannot be damaged by any corrosive atmosphere in which it may be used. The **new** precision hot molded arc hood confines the arc and increases the interrupting capacity.

ALLEN-BRADLEY

Bulletin 709
Quality Motor Control

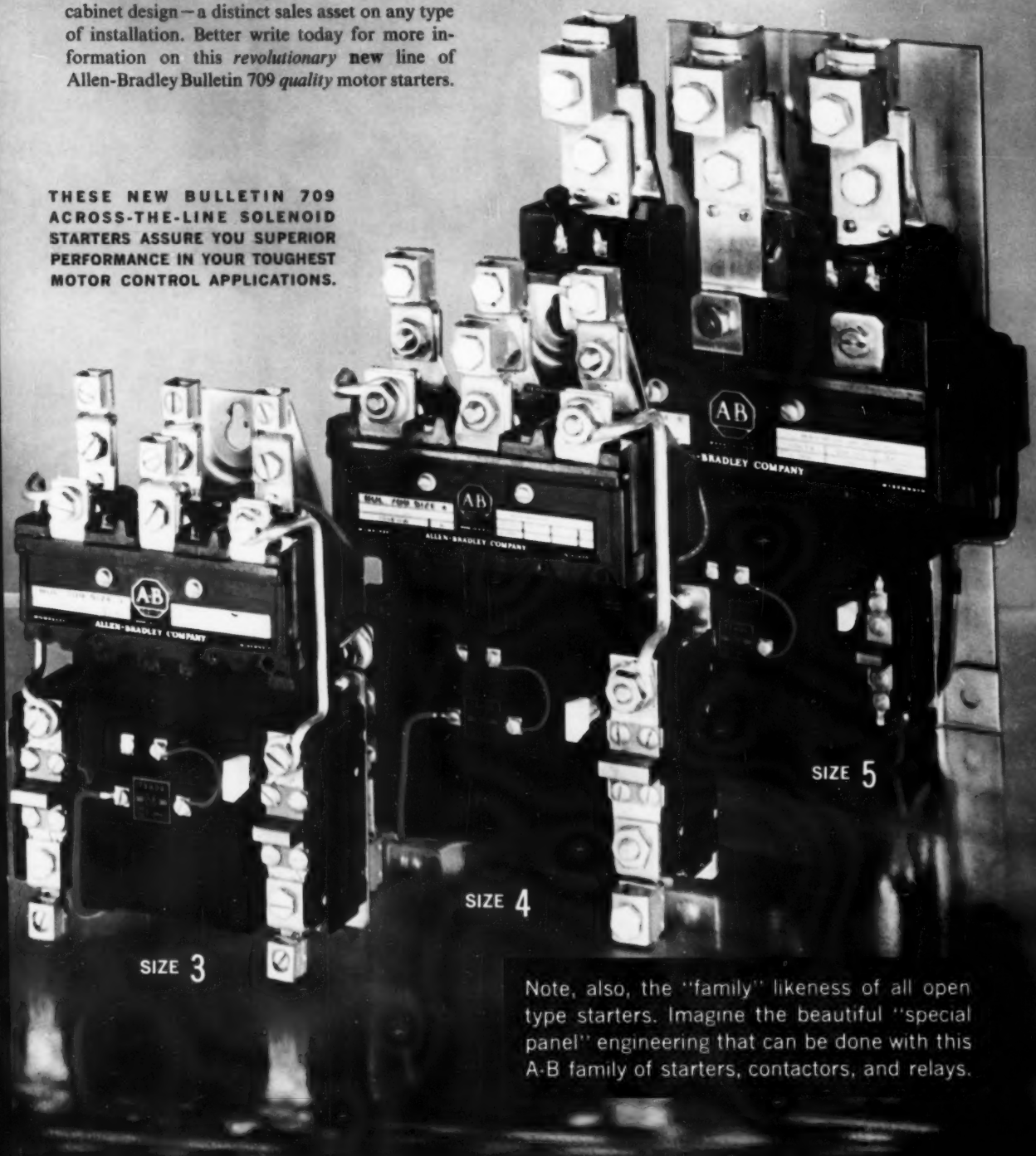
A-B QUALITY

control...in 30 years!

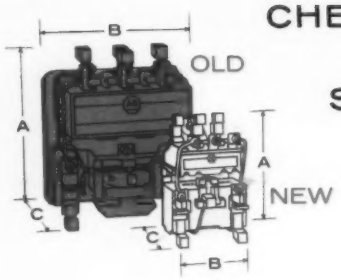
New weld-resistant, cadmium oxide silver contacts close and seat firmly, eliminating the sliding motion that causes wear. The overload relays are also **new** and are not only completely *trip-free* but also *tamperproof*. Of course, they were designed to use the **old** Bulletin 709 heating elements you have in stock.

Brooks Stevens is responsible for the smart cabinet design—a distinct sales asset on any type of installation. Better write today for more information on this *revolutionary* **new** line of Allen-Bradley Bulletin 709 *quality* motor starters.

THESE NEW BULLETIN 709 ACROSS-THE-LINE SOLENOID STARTERS ASSURE YOU SUPERIOR PERFORMANCE IN YOUR TOUGHEST MOTOR CONTROL APPLICATIONS.

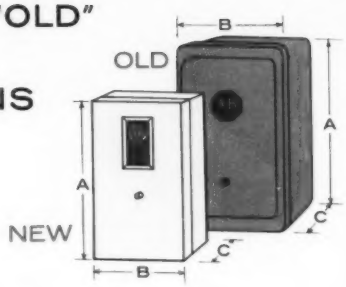


Note, also, the "family" likeness of all open type starters. Imagine the beautiful "special panel" engineering that can be done with this A-B family of starters, contactors, and relays.



CHECK THE "NEW" WITH THE "OLD" BULLETIN 709 SPACE-SAVING DIMENSIONS

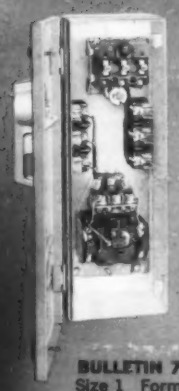
The wiring room in the new enclosure will delight the electrician.



TOTAL OVER-ALL DIMENSIONS

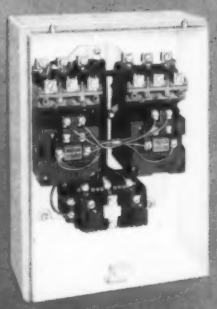
Starter Size	OPEN TYPE STARTERS						NEMA 1 ENCLOSURES					
	NEW			OLD			NEW			OLD		
	Height A	Width B	Depth C	Height A	Width B	Depth C	Height A	Width B	Depth C	Height A	Width B	Depth C
00	3 5/8	3 7/8	3 9/16	—	—	—	7 5/8	4 7/8	4 1/4	—	—	—
0	5 7/8	4 1/16	3 1 1/16	5 5/8	4 3/4	3 1/4	9 1/8	6 5/16	4 3/8	7 7/8	5 5/8	4 1/4
1	6 5/8	4 1/2	3 1 1/16	5 7/8	5	3 1/4	10	6 13/16	4 3/8	8 13/16	6 3/8	4 1/4
2	7 3/4	4 5/8	3 1 1/16	10 1/16	5 3/4	4 7/32	12	7 5/8	4 3/8	14 1/2	9	5 7/16
3	10 1/4	6 1/4	5 7/16	12 5/8	7 1/4	5 7/16	16 5/8	10 3/8	7	19 1/2	11 3/8	6 1 1/16
4	11 7/16	7 5/16	6 1/4	16 1/4	12 3/4	6 1 5/16	22	11 5/8	8	26 9/16	14 3/16	7 1 1/16
5	14 1 3/16	9	6 1/2	20	16 1/8	8 3/4	32 3/16	17 3/16	9 7/8	41 1/2	19 9/16	13 3/16

Also...other across-the-line starters in the NEW A-B design!

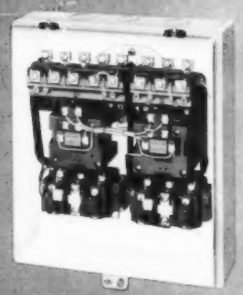


BULLETIN 712
Size 1 Form 2F
Fused Disconnect

BULLETIN 713
Size 2 Style RT
Circuit Breaker



BULLETIN 705
Size 1 Style RT
With Overload Relays



BULLETIN 715
Size 1 Two Speed
Consequent Pole

ALLEN-BRADLEY

Member of NEMA

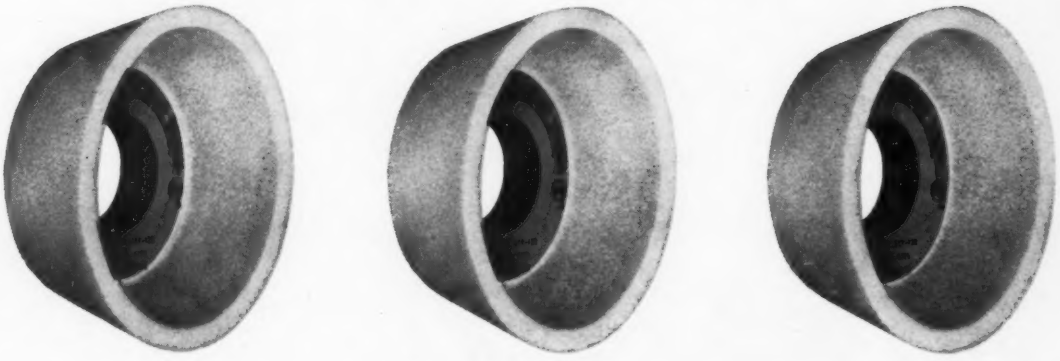
Quality Motor Control

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wisconsin

A-B QUALITY

9-61-RM

POSITIVE DUPLICATION—EVERY TIME!



Music to please you is identically reproduced by these three hi-fi records pressed from the same master recording. The three toolroom grinding wheels (above) will also please you with their masterly Positive Duplication. That's because they are CINCINNATI (PD)° GRINDING WHEELS.

FAMOUS, UNIQUE (PD) PROCESS

Unique in the industry, the famous Cincinnati (PD) manufacturing process is governed by 36 unvarying quality control steps. Print-weigh tickets, for example, must match the weights for every mix—*exactly* as specified on the Master Card which controls every operation in the rigid procedure.

UNIFORM, PREDICTABLE PERFORMANCE

This extraordinary attention to manufacturing detail results in wheels of unsurpassed uniformity.

You can reorder CINCINNATI WHEELS with confidence, because they give you the same good job time after time after time. You use fewer (PD) wheels because they last longer.

CALL CINCINNATI TODAY

Factory trained by the Cincinnati Milling Machine Company, our grinding specialists are available to you for consultation on all your grinding problems. Call your CINCINNATI GRINDING WHEELS Distributor, or contact us direct, Cincinnati Milling Products Division, Cincinnati 9, Ohio.

(PD) POSITIVE DUPLICATION

CINCINNATI° GRINDING WHEELS

°Trade Mark Reg. U.S. Pat. Off.

A PRODUCTION-PROVED PRODUCT OF THE CINCINNATI MILLING MACHINE CO.

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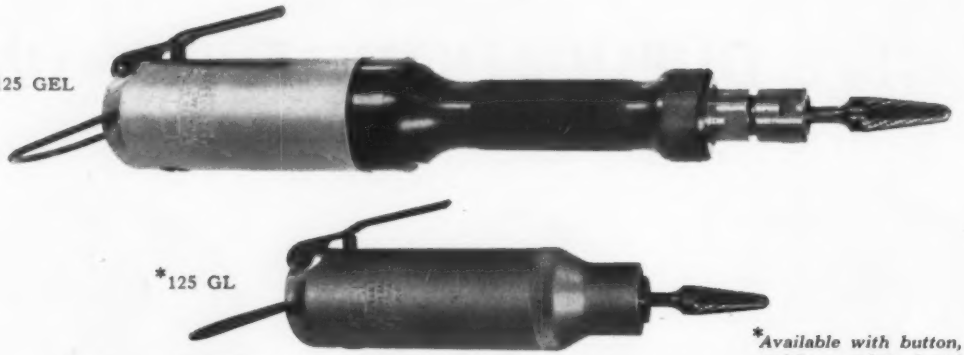
New from Cleco

125 DIE GRINDER

Especially designed as a heavy duty die grinder for use with 3/8" shank carbide burs



**Available with button, lever and quick-as-a-wink throttle.*

The Cleco 125 (23,000 RPM) Die Grinder is a *new* development in metal removing, using heavy duty carbide burs and mounted points. It features what you have asked for in heavy duty die grinding—lighter weight, greater horsepower, more speed, no vibration.

Excellent for hand routing operations and fast metal removal with ⅜" or ¼" shank carbide burs, the Cleco 125 Die Grinder extends the use of carbide burs into new fields.

Standard on all models is a metering valve that allows the operator to reduce the RPM for non-ferrous applications, such as cleaning aluminum castings. The metering features of the 125 Die Grinder coupled with high motor horsepower make it adaptable to ferrous and non-ferrous work.

For complete information on the Cleco heavy duty 125 Die Grinder, call or write—

CLECO AIR TOOLS

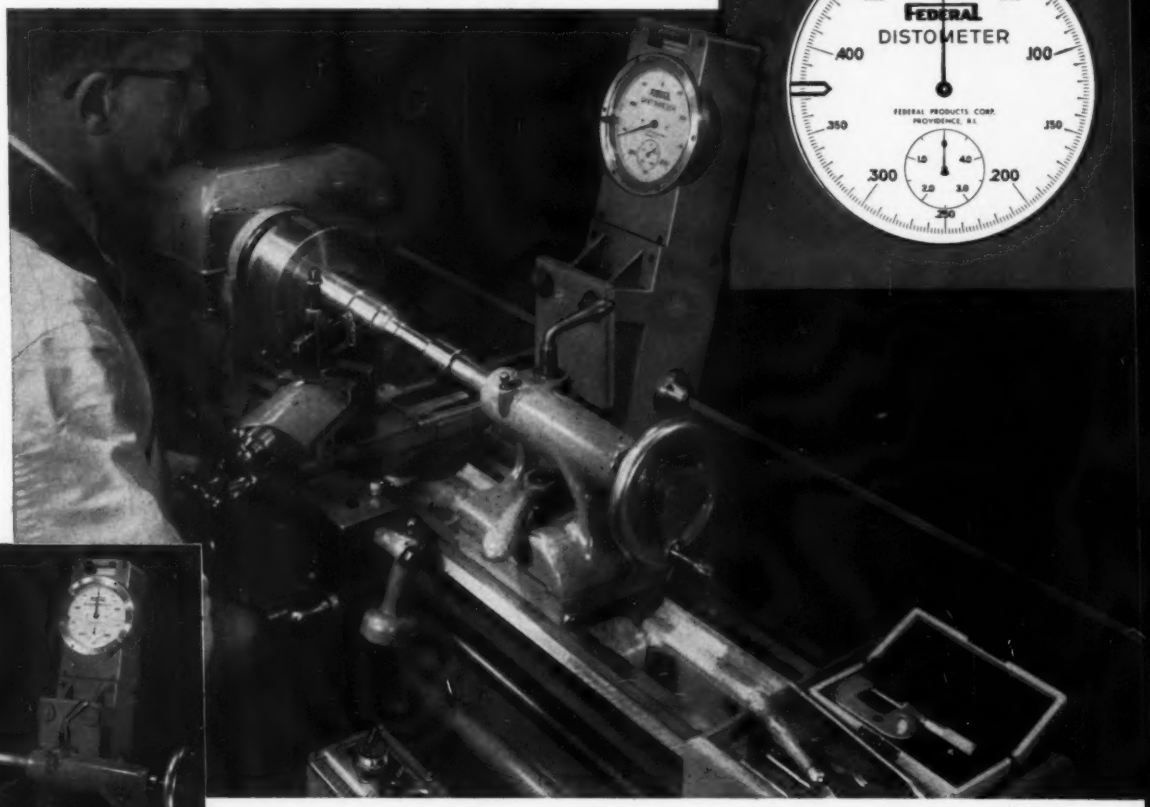
"quality tools engineered for industrial progress"

A Division of Reed Roller Bit Company P. O. Box 2541, Houston 1, Texas, U.S.A.

IN CANADA: Cleco Pneumatic Tool Company of Canada, Ltd., 927 Millwood Road, Leaside (Toronto) Canada

Right before your eyes...

A 27% (or more) INCREASE in LATHE PRODUCTIVITY!



Push-Button Zeroing . . . you're instantly and automatically ready to measure off the next distance.

The DISTOMETER, a totally new precision instrument, greatly increases lathe output . . .

Because —

- It provides a much faster, more convenient and more reliable means of spotting tool position and measuring longitudinal cutting distance than any other available device.
- It has motorized, Push-Button Zeroing. Lets you reference instantly at any point in the carriage travel for continuous measurement to any other point.
- It puts accurate, well magnified, man-size readings in front of the operator so he can follow progress of the tool and know instantly when it has covered the required distance.
- It requires no set up, no positioning, no mastering. Ready to measure *directly* at the touch of a button.

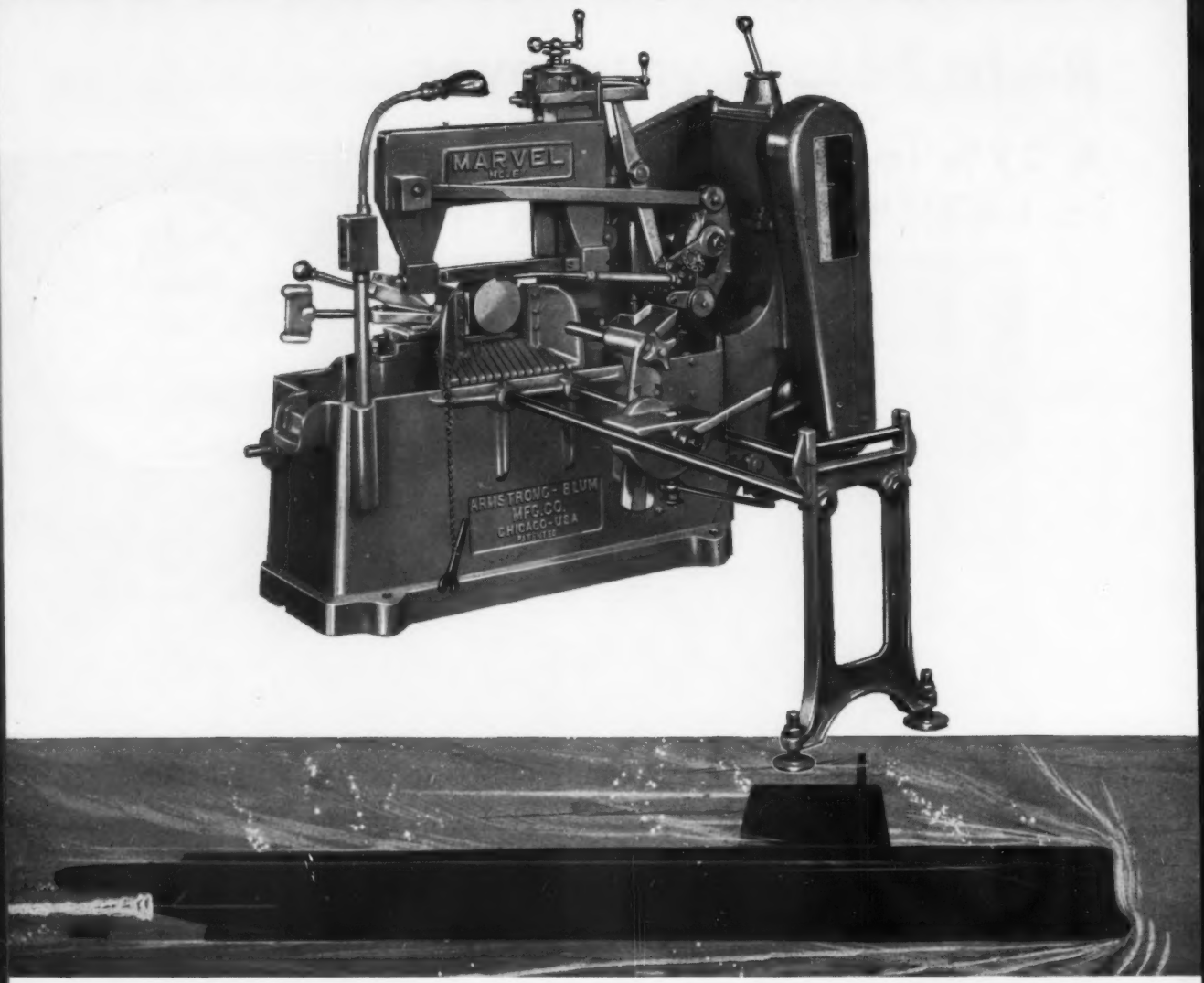
ANY MANUALLY OPERATED LATHE . . . OLD OR NEW . . . BIG OR SMALL . . . CAN USE THE DISTOMETER PROFITABLY!

Write for brochure.

FEDERAL PRODUCTS CORP.
1114 Eddy Street, Providence 1, R. I.

Ask **FEDERAL** *First*

FOR RECOMMENDATIONS IN MODERN GAGES . . .
Dial Indicating, Air, Electric, or Electronic—for Inspecting, Measuring, Sorting, or Automation Gaging



OBSOLETE ?

Emphatically no—not when a Marvel Hack Saw like this one can cut 4600 blanks of 3¼" round 303 stainless steel for just 1½ cents blade cost per cut—not when these 4600 blanks were cut-off at the rate of 20 pieces per hour, floor to floor! And this is typical production performance at that.

Obsolete? This Marvel Hack Saw Machine is as modern in performance as the next atomic powered submarine that will slide down the ways!

If you want faster cutting, the Marvel Hack Saw has speed to spare; accuracy of cut is assured by the rugged construction of the machine itself; blade cost, in many cases is less than 1¢ per cut.

When you consider these advantages and their low initial cost, Marvel No. 6 and No. 9 Series High Speed Heavy Duty Ball Bearing Hack Saws, as we build them, are your best cutting-off equipment buy today.

We can prove our point by demonstrating Marvel Sawing efficiency on your own work, without any obligation on your part. Because we have consistently built both Hack Saws and Band Saws for more than 40 years, we will give you an unbiased recommendation.

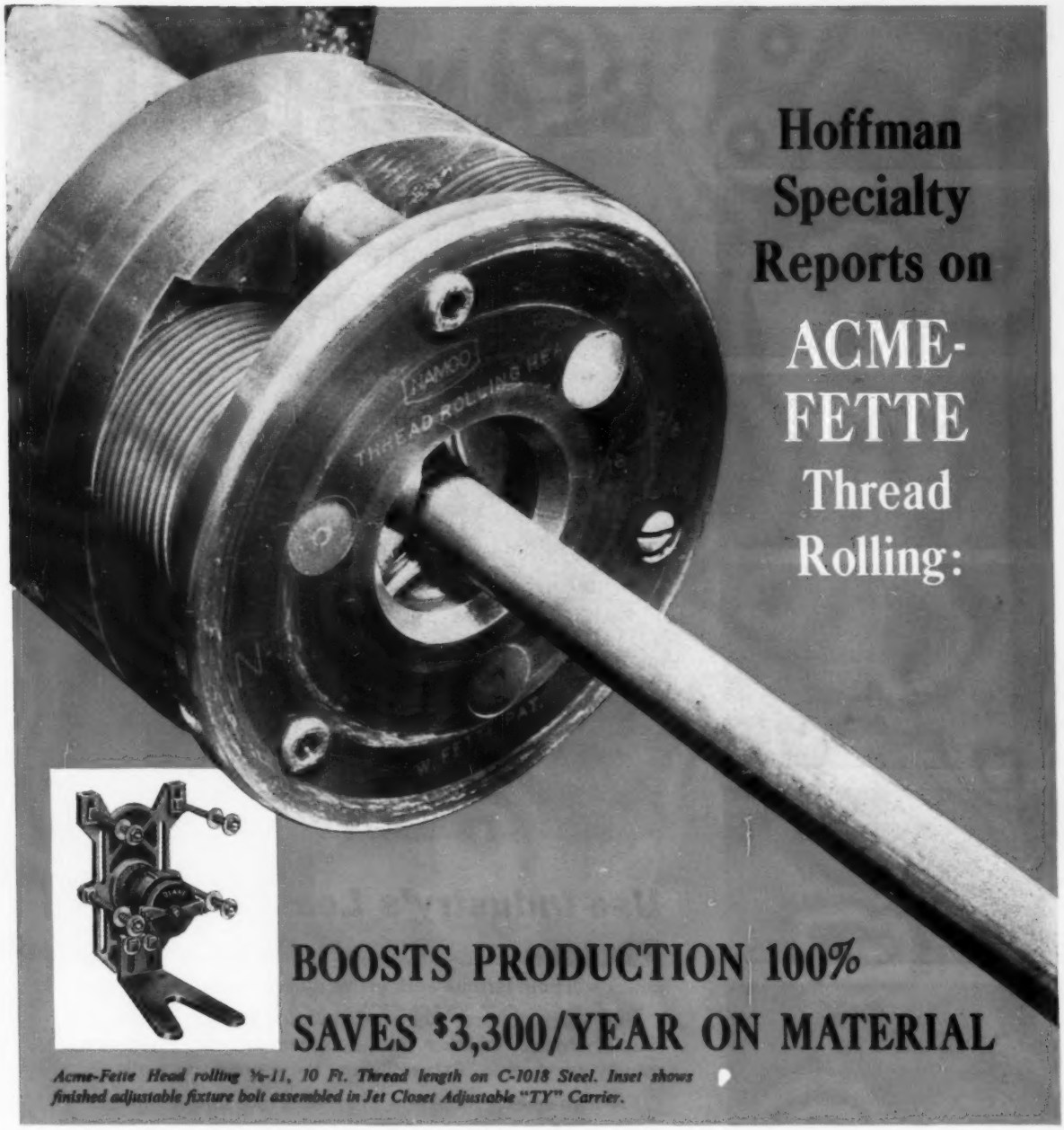
Catalog C-60 illustrates and describes the complete line of Marvel Sawing Machines. Write for your copy.

MARVEL *Metal Cutting* **SAWS**

BETTER MACHINES
BETTER BLADES

ARMSTRONG-BLUM MANUFACTURING CO. • 5700 Bloomingdale Avenue • Chicago 39, Illinois

S-1317



Acme-Fette Head rolling ⅜-11, 10 Ft. Thread length on C-1018 Steel. Inset shows finished adjustable fixture bolt assembled in Jet Closet Adjustable "TY" Carrier.

"Doubled production . . . saved us $3,300 on material alone . . . rolled over sixteen *miles* of thread with same set of rolls . . . produced stronger, more easily-assembled threads with finer finishes . . ." This is the Blake Division of Hoffman Specialty Manufacturing Corporation describing a year's operation with an Acme-Fette N-3 Self-Opening Thread Rolling Head. Such superior performance is easily explained: Because the Acme-Fette Head generates the thread progressively from the front of the rolls, metal flows to the thread's full depth eliminating broken grain structure and cratering at the thread crest. The result is a thread with a high grade burnished surface, remarkably resistant to wear and corrosion. And, Acme-Fette Heads roll any parallel or tapered thread from 1/16" to 2" up to *5 times faster* than thread cutting tools. Get full details. Send for Bulletin NAF-57A.

ROLLED THREADS ARE BEST... ACME-FETTE'S BEST FOR ROLLING

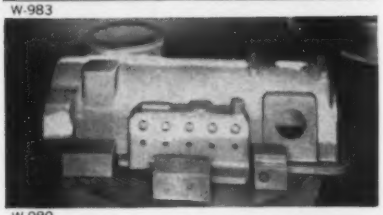
National Acme

THE NATIONAL ACME COMPANY
179 E. 131st STREET
CLEVELAND 8, OHIO

Sales Offices: Newark 2, N. J., Chicago 6, Ill., Detroit 27, Mich.

For more data circle this page number on card at back of book

W-983



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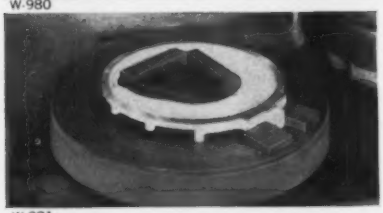

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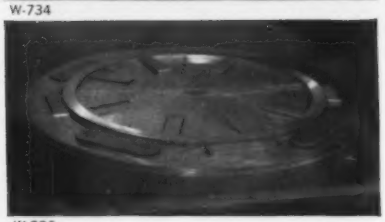

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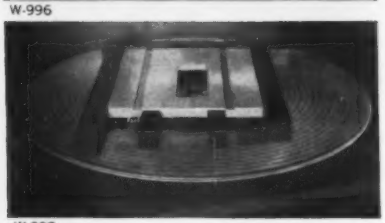
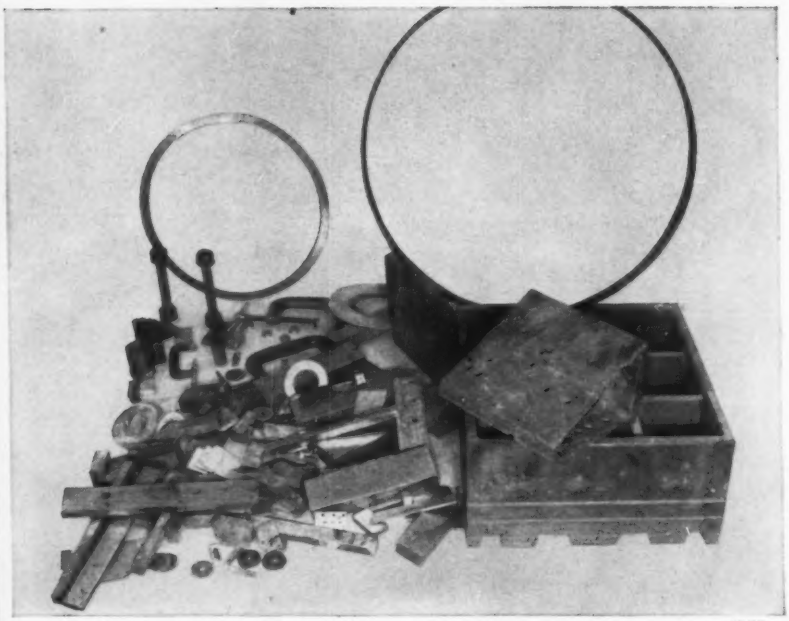


W-998

BLANCHARD GRINDERS



M-59

Use Industry's Least Expensive Fixtures . . .

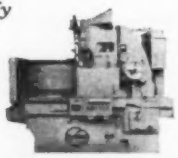
Normally, the Blanchard magnetic chuck will hold ferrous work pieces during the grinding cycle.

But when fixtures *are* needed — for holding irregular-shaped objects, whether ferrous or non-ferrous — you can usually select your "fixtures" from the nearest scrap pile.

For high-speed production, close-tolerance finishes and the most versatile grinding capabilities in existence . . . *put it on the Blanchard!*

Write today for your free copy of "Work Done on the Blanchard", Fifth Edition, and "The Art of Blanchard Surface Grinding", Fourth Edition.

For Best Results, Always Specify Blanchard Grinding Wheels for Blanchard Grinders.

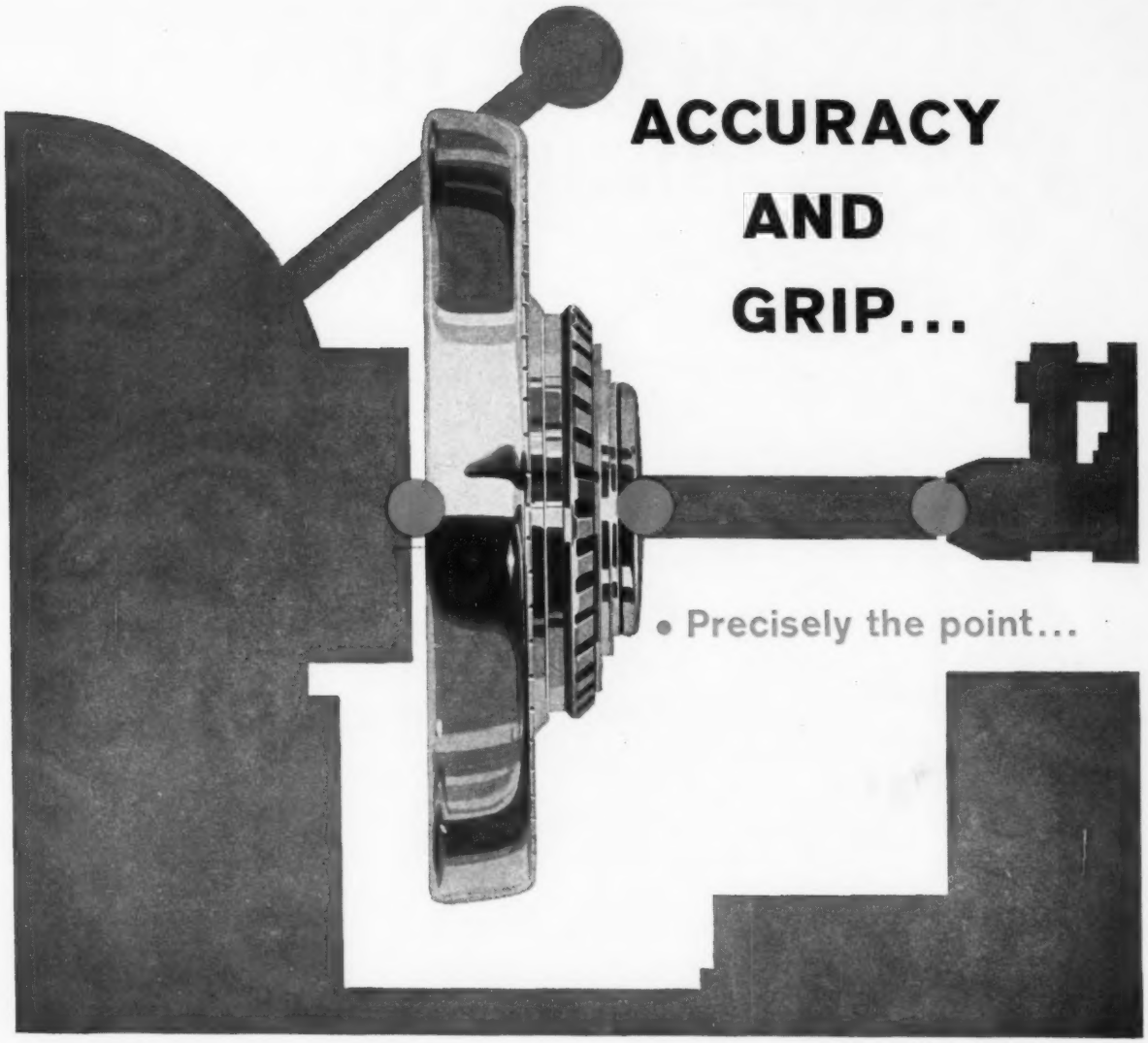


No. 18

PUT IT ON THE BLANCHARD

THE BLANCHARD MACHINE COMPANY

64 State Street, Cambridge 39, Massachusetts



When you buy new tools or rebuild old ones

START UP FRONT

- Precisely the point where the tool does its work.
- Precisely the point where profits are made and lost.
- Precisely the point where the accuracy and grip of Jacobs Chucks reduce tool breakage, downtime and rejects.

This is precisely the point, start up front with Jacobs.

The Jacobs Model 91 is the world's finest lathe collet chuck. Developed expressly for the world's finest engine and tool room lathes. Modernize your lathes with Model 91.

- It has the **range**—each collet has full 1/8" range and set of 11 chucks any bar between 1/16" and 1 3/8".
- It has the **grip**—two to four times as much as split steel collet equipment.
- It has the **accuracy**—the world's most accurate collet chuck. Manufactured to maximum runout limits of .0007"—T. I. R. at the nose.

INDUSTRIAL TEAMWORK

Your industrial supply distributor knows your business. He is always ready to fill your needs quickly and economically. When you need chucks you can depend on this industrial team—Jacobs and your Jacobs industrial supply distributor.

Jacobs CHUCKS

THE JACOBS MANUFACTURING COMPANY,
WEST HARTFORD, CONNECTICUT

For more data circle this page number on card at back of book

HITACHI
NO. 2 ML MILLING MACHINES

No. 2 ML Plain Milling Machine

Vibration Damping Device
Due to a vibration damping device of Hitachi's exclusive design contained within the over-arm, minimum vibration will be set up even during higher speeds and feeds operation, so that an excellent finished surface is obtained.

New-Type Arbor Support Bearing
Hitachi's unique super precision-type bearing, a combination of plain metal and needle bearing, is incorporated into the machine to enable high speed cutting with high precision results.

Mono-Lever Control System
Hitachi's unique Mono-lever Control System makes the operation simple and easy. Table-feeding too can be performed with ease.

Backlash Eliminator of Lead Screw
As the use of two independent nuts eliminates backlash on the table feed screw, smooth down-cutting can be effected.

SPECIFICATIONS :

- 53 1/8"×10 1/16" Table
- 28" Longitudinal Traverse
- 16 Table Feeds 1/16" — 78 3/4"/min.
- 16 Spindle Speeds 25 — 1,500 r.p.m.
- 7.5 h.p. Main Motor

Hitachi, Ltd.
Tokyo Japan

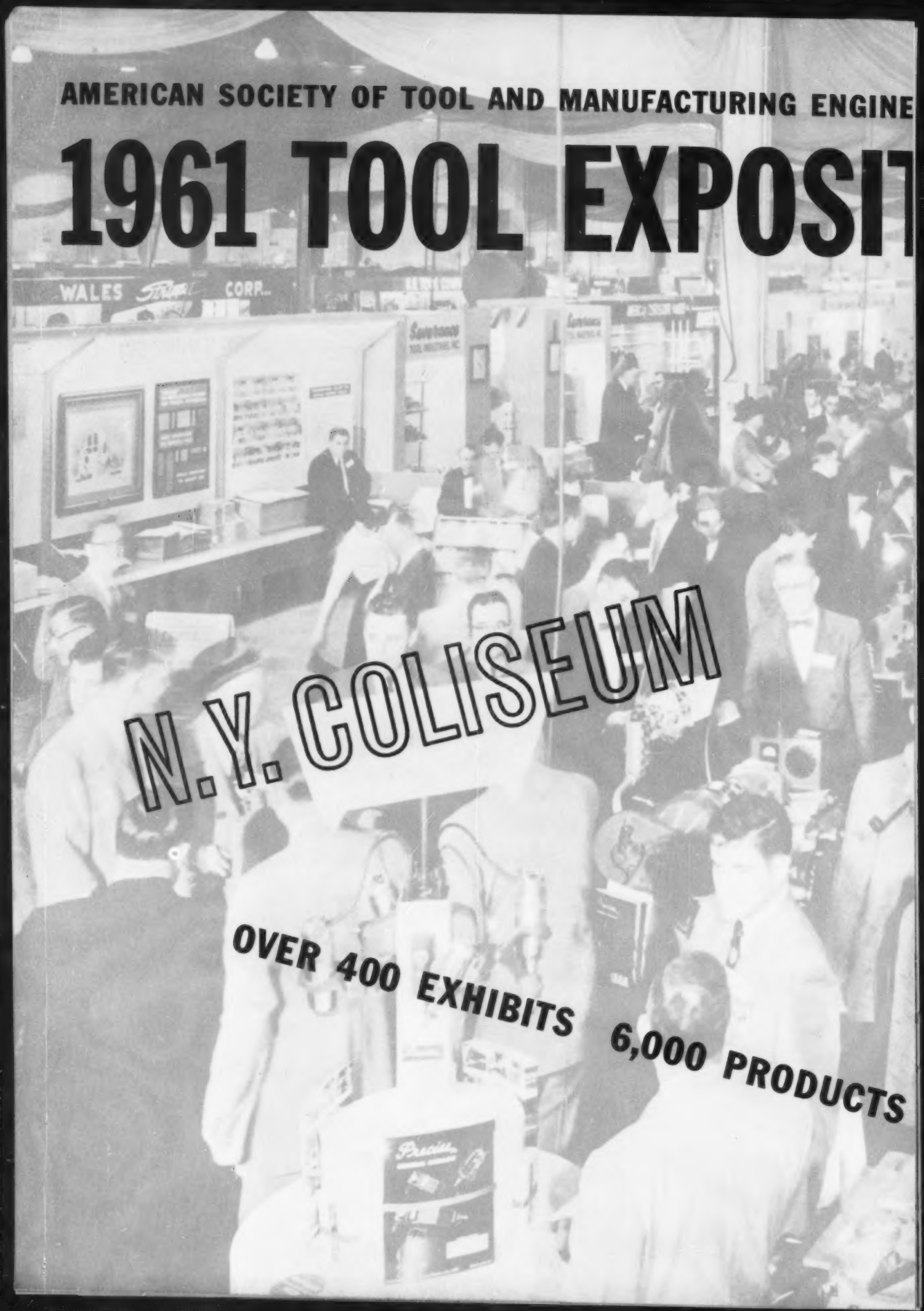
Cable Address : "HITACHY" TOKYO

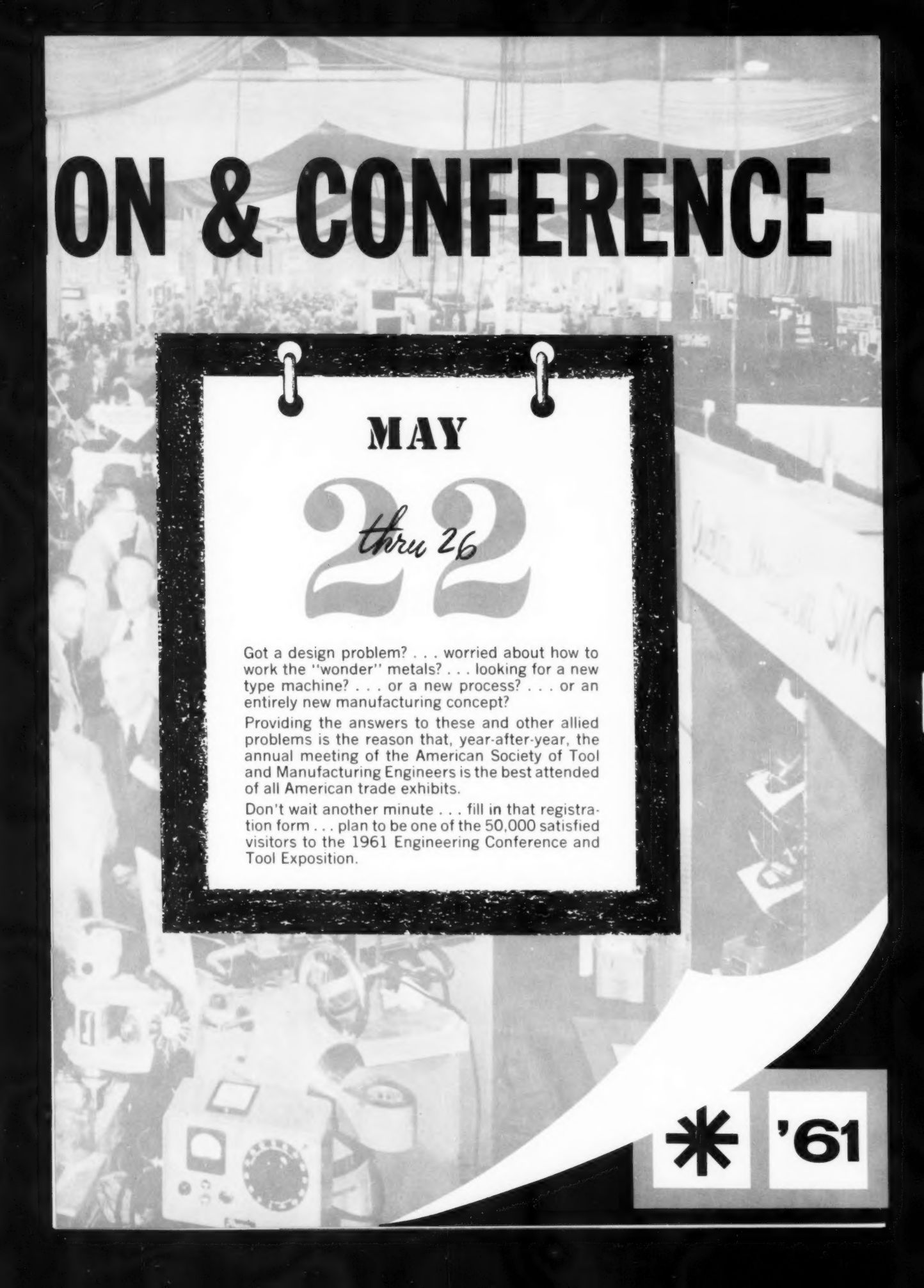
This is the national show that gives you twice as much for your money—everything that's new and important in manufacturing, production, engineering, research and development—plus fabulous New York City, too.

You'll see the very latest in all types of manufacturing equipment . . . you'll see improvements in current techniques and procedures . . . you'll see developments so fresh from the drawing boards that you're virtually looking at "originals" . . . and you'll see display after display of equipment and parts and techniques . . . all designed to help you meet and conquer the challenges of both today—and tomorrow.

You'll sit in on conferences and symposia designed to give you the latest technical and scientific information—and you'll rub shoulders with America's top management, engineering, production, purchasing and sales people.

So, Sign up NOW for 1961's BIG Show in the BIG City!


AMERICAN SOCIETY OF TOOL AND MANUFACTURING ENGINE
1961 TOOL EXPOSIT
WALES
CORP.
N.Y. COLISEUM
OVER 400 EXHIBITS
6,000 PRODUCTS



ON & CONFERENCE

MAY

22 thru 26

Got a design problem? . . . worried about how to work the "wonder" metals? . . . looking for a new type machine? . . . or a new process? . . . or an entirely new manufacturing concept?

Providing the answers to these and other allied problems is the reason that, year-after-year, the annual meeting of the American Society of Tool and Manufacturing Engineers is the best attended of all American trade exhibits.

Don't wait another minute . . . fill in that registration form . . . plan to be one of the 50,000 satisfied visitors to the 1961 Engineering Conference and Tool Exposition.

'61

INFORMATION & INSPIRATION

Just take a look at the typical information-packed conferences and symposia scheduled below, and we think you'll agree . . . you can't help but find here the information and inspiration you and your top people need to successfully meet today's conditions, tomorrow's challenges.

Surface Metrology Seminar
Surface Specifications, Measurement Techniques, Predictions of Future Requirements and Developments

Material Removal Symposium
Ultra High Speed, Electrolytic and Electron Beam Machining

Manufacturing with Numerical Control Systems

Use of Computers in Manufacturing Operations Management

Application of Explosives in Metal Forming

Workhold Developments
Electrostatic chucking and Fiberglas reinforced Plastic Clamping

Numerically Controlled Machining Operations

Operations Research . . . Process Planning

Machining Malleable Iron and Cast Iron

Press Tooling and Die Design

Heat Treating Instruments

Metal Cutting Carbides

Work Simplification

Precision Grinding

FOR ADVANCE REGISTRATION and all the advantages it brings just fill in the form below and mail it NOW, with registration fee to the American Society of Tool and Manufacturing Engineers, 10700 Puritan Ave., Detroit 38, Mich. If you mail **before May 1st** you will receive, FREE, a $10,000 ACCIDENTAL DEATH and DISMEMBERMENT POLICY covering you, 24 hours a day, from the time you leave home until you return . . . **plus** a time-saver Guest Badge that eliminates waiting in line at the Coliseum. After May 1st, bring your filled out registration card with you . . . save the time of filling it out at the Show.

'61

ADVANCE REGISTRATION CARD

ASTME 1961 CONVENTION

NEW YORK COLISEUM • MAY 22 THRU 26

Fill in COMPLETELY and LEGIBLY and mail, with registration fee, to . . .

American Society of Tool and Manufacturing Engineers
10700 Puritan Ave.
Detroit 38, Michigan

MAIL PRIOR TO MAY 1st FOR FULL ADVANCE REGISTRATION BENEFITS

YOUR NAME _____ TITLE _____

COMPANY NAME _____

COMPANY ADDRESS _____

CITY _____ ZONE _____ STATE _____

COMPANY'S BUSINESS OR PRODUCT _____

BENEFICIARY'S NAME _____

Check one ▶ ☐ Member's (Fee $1) ☐ Non-member (Fee $2)

- over 400 EXHIBITS
- 21 TECHNICAL SESSIONS
- 12 PLANT TOURS
- 6 SPECIAL EVENTS

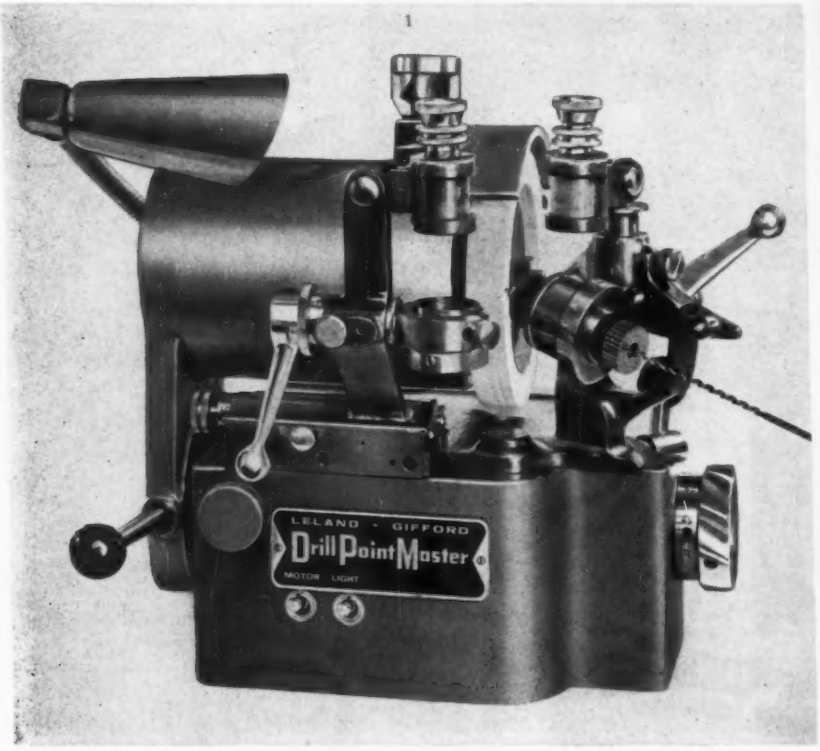
EXHIBIT HOURS

Monday and Tuesday
1:00 pm to 9:00 pm

Wednesday thru Friday
9:00 am to 5:00 pm

UNIQUE NEW DRILL SHARPENER

DUPLICATES ANY POINT GEOMETRY — SHARPENS, RELIEVES AND THINS WITH MICROMETER ACCURACY



Drill Point Master

EXCLUSIVE FEATURES

- A precision machine with rigid cast iron frame and bearing bronze components.
- Point angle adjustment set from 60° to 180° included angle.
- Lip relief adjustment from 0° to 26°.
- Wheel slide and point thinning carrier micrometer adjusted.
- One collet chuck serves both sharpening and thinning positions.
- Only a few collets needed for all drill sizes.
- Special sandwich wheel for clean, dry grinding and thinning without burning.
- Two variable power microscope viewers plus sealed beam light for precise setting and inspection.

LELAND-GIFFORD's new Drill Point Master represents a completely new concept in a precision drill grinder. It is capable of producing or reproducing any desired point on any drill from #80 to .250" diameter.

Drills sharpened and pointed on the Drill Point Master cut *four* clean chips — the sign of a perfectly sharpened drill. Drills start easily without walking, raise little or no burr, can be fed with less thrust pressure or at much higher feed rates. You get longer drill life, cleaner, rounder, straighter holes and more production in any material . . . and the Drill Point Master is often the only solution to drilling true holes in super alloys and exotic materials.

At its moderate price, it will pay you to put a Drill Point Master beside every machine doing critical work — as well as in your toolroom. Write, wire or phone for an in-plant demonstration — or for complete information.

LELAND-GIFFORD

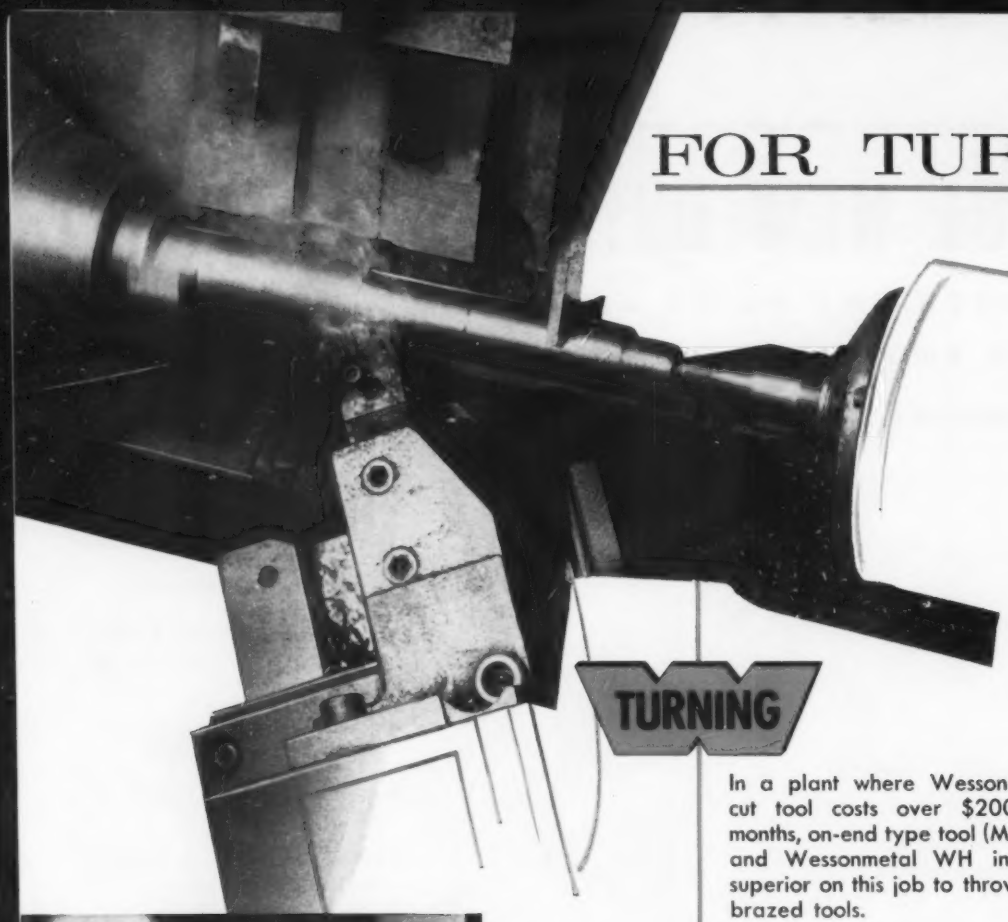
WORCESTER 1, MASSACHUSETTS

DRILL POINT MASTER DRILL GRINDER

For more data circle this page number on card at back of book

FOR TURNING . .

how to



TURNING

In a plant where Wesson job-analysis cut tool costs over $200,000 in 18 months, on-end type tool (MX8-T5 holder and Wessonmetal WH insert) proved superior on this job to throw-aways and brazed tools.

BORING

A Wesson man pre-engineering the tooling for boring track-links of 325 Brinell. Result: over 200 pcs. per grind from the start. Wessonmetal solid WH inserted blades used.

MILLING

Safety at almost 1½ miles a minute is job-engineered into this Wesson T-72 Rigidcut with Wessonmetal GI blades. The faster it cuts, the tighter the blades seat. Lubrication is centrifugal to each blade through holes in the body . . . and you don't have to reset blades every time you grind.

WESSON COMPANY • WESSON RESEARCH •

. . THROW-AWAYS, ON-END TYPE, or BRAZED?

make it easier to decide...

With the new Wesson T-A holder, old troubles with throw-away holders for turning have disappeared like magic. Easily indexable in any position, with only two major units, fully adjustable, the new Wesson T-A is the result of 3 years of research and 25 prototypes.

New developments like this make it important to take another look at your own tooling. Where will it fit in best? Where will Wesson band-type or brazed type tools do better? Here the Wesson man in your area can be of real help to you:

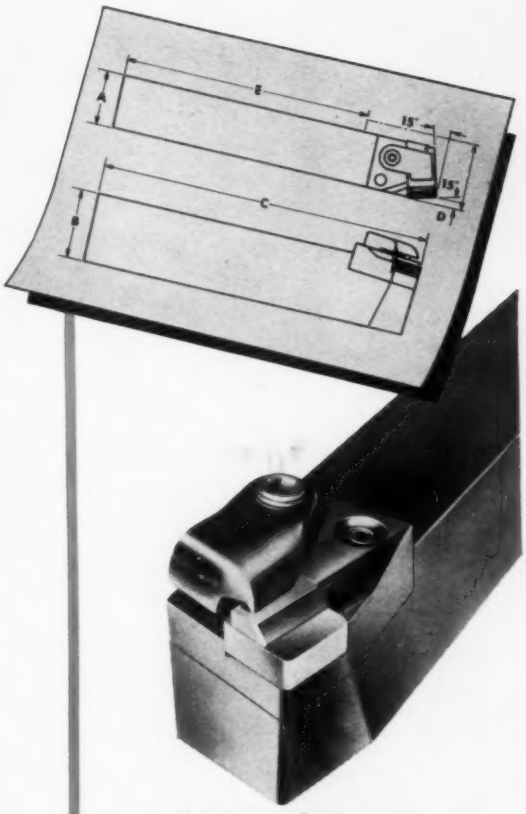
1. **His recommendations will be unbiased, since Wesson makes ALL THREE types**
2. **He has a thorough knowledge of which works best under different conditions**
3. **He was picked for his turning, boring and milling know-how**
4. **He will job-engineer your applications in your plant**
5. **He will see to it that the tools you buy will give you best possible performance**

Let him work for results in your plant like those shown at the left. He costs you nothing. He is as near as your telephone.

He is backed by the combined experience of the entire group of Wesson's 4 specialized tool plants, plus Wesson's basic research and tool engineering groups, plus Wesson's own carbide metals plant.

Ask him for a copy of "HOW TO TURN WITH THROW-AWAYS, BAND TYPE OR BRAZED TOOLS". Or, if you prefer, ask us for a copy right now. It helps you make it easier to decide which type of tool to use.

Wesson Company, 1220 Woodward Heights Blvd., Ferndale 20, Michigan. In Canada: Wesson Cutting Tools Ltd., 93 Judge Road, Toronto 18, Ontario.



New and Now In Mass Production

The Wesson T-A (throw-away) holder is simplicity itself . . . to use, to index, to stock. It has only two units . . . the shank with its 2 in 1 flat-seat anvil-locator and the clamp unit with wide range adjustment and adjustable solid carbide chip-breaker. Ask for Bulletin T-160.

WESSON

• ARCHER & SMITH • WESSON MULTICUT CO. • WESSON METAL CORP. • WESSON CUTTING TOOLS LTD. •

For more data circle this page number on card at back of book

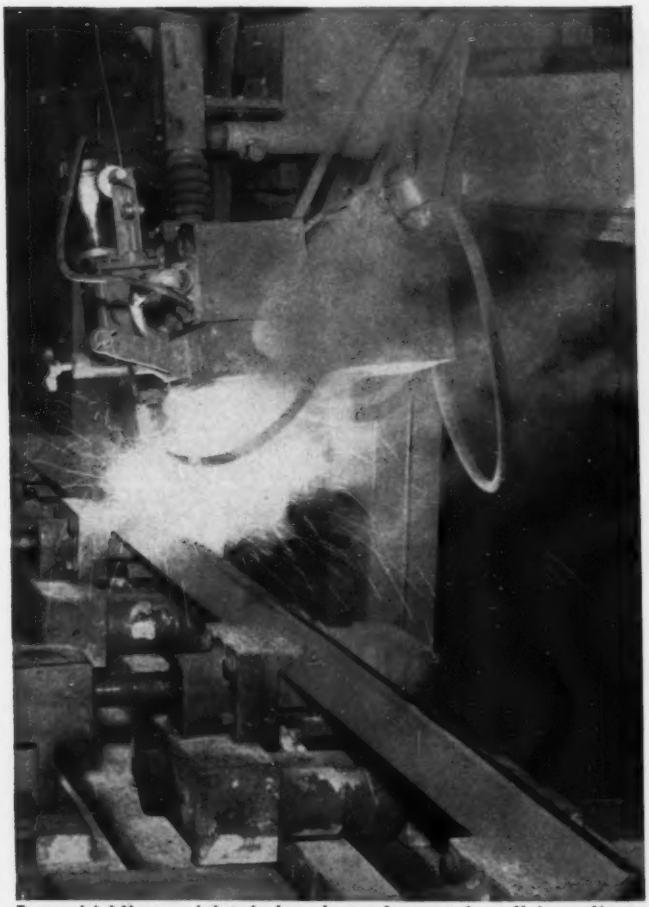
Leading automaker saves because . . .

INNERSHIELD ELIMINATES

Two Innershield heads moving horizontally with two moving elliptically weld brackets to rear axle in 4½ seconds. No separate flux or gas systems needed.

COSTLY FLUX HANDLING

Lincoln's new Innershield process is clean. No need for expensive flux handling and recovery systems. No abrasive dust to wear out costly, complex fixtures. Atmosphere stays cleaner, simplifies housekeeping, improves working conditions. No slag removal problems.



Innershield's special tubular electrode contains all ingredients for welding—fluxes, deoxidizers, filler metal. No Argon or CO_2 needed. Here, Innershield welds angle iron for farm machinery part at 80 ipm compared to 40 ipm with CO_2. Tanks, hoppers, structural beams all are now welded with this process, too.

Semi-automatic Innershield Squirt lets an amateur turn pro in minutes. Electrodes bridge gaps caused by poor fitup. Slag flicks off with a swipe of the electrode tip. Have a Lincoln field engineer show you how Innershield Squirt can increase the operating factor and deposition rates on your jobs.

New brochure describing Innershield process and full and semi-automatic equipment is just off the press. Get your copy now. Write The Lincoln Electric Company, Dept. 2211, Cleveland 17, Ohio.

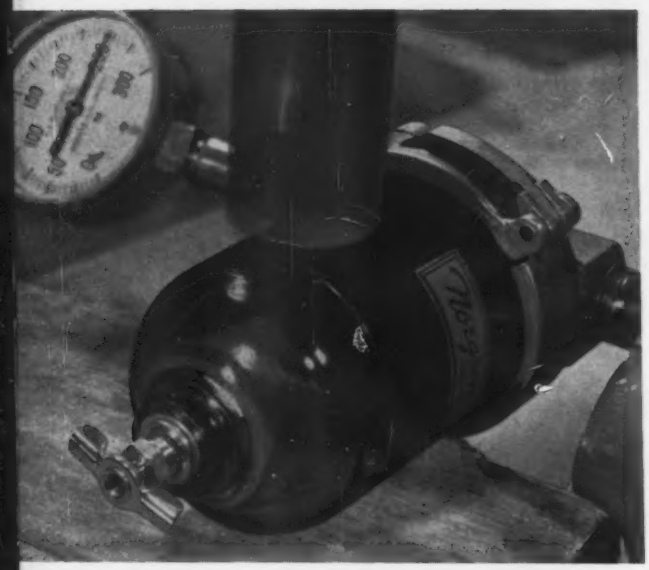
LINCOLN WELDERS

THE WORLD'S LARGEST MANUFACTURER OF ARC WELDING EQUIPMENT AND ELECTRODES

NEW NORGREN SAFETY GREEN* TRANSPARENT BOWL WITHSTANDS RIPPING IMPACT OF BULLETS

*TRADEMARK

Norgren SAFETY GREEN* bowl doesn't shatter... yet is fully transparent



Heavy steel bar dropped endwise from 12 ft. height merely scuffed surface of bowl carrying over 200 psi internal pressure.

Bowls for compressed-air-line filters and lubricators should be transparent to permit quick visual inspection. However, in the past, unusual or special applications often required the use of bowl guards or wire reinforcements . . . sacrificing the advantage of transparency.

Now . . . from Norgren . . . you get a fully transparent, yet super-tough, impact-resistant bowl designed for even the most severe service. As these photos dramatically portray, the new Norgren bowls are transparent and are able to withstand conditions far more exacting than ever encountered in ordinary use. Nonshattering bowls mean reduced replacement cost, less air-tool and equipment down-time, savings in maintenance and operating costs, greater employee safety.

These new SAFETY GREEN* bowls are now available for most Norgren air-line filters and lubricators—or may be obtained separately for replacement purposes from your local Norgren representative or distributor. Or, write for full information.

As a further test of toughness, the new Norgren bowl was placed in a heavy machine shop vise . . .

then compressed almost flat. Even in this extreme position, the bowl did not break or even crack.

Turned and squeezed again back to its original shape, the bowl still showed no cracking. Except for vise marks almost good as new!

...WITH NO SHATTERING!

Unretouched high-speed photo by University of Denver Research Dept. shows new Norgren SAFETY GREEN Bowl a split second after penetration by bullet. Initial pressure of 265 psi is being relieved through bullet hole.

Specify Norgren SAFETY GREEN Bowls

Large photo shows bowl after test. Only damage to bowl is clean bullet hole with no cracking, crazing or shattering. Impact has broken gauge. This test clearly demonstrates extreme toughness of Norgren SAFETY GREEN bowls.

FOUNDED IN 1926

. . . for complete information, write

C. A. NORGREN CO.

3419 SOUTH ELATI STREET ENGLEWOOD, COLORADO

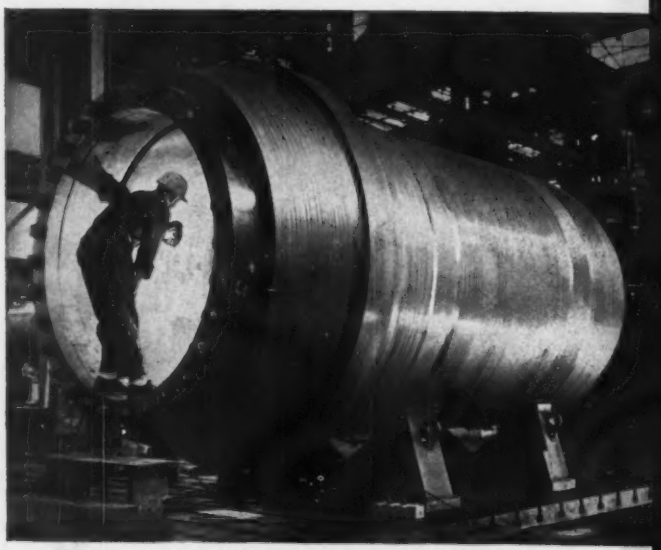
You name it...we'll forge it!

RIGHT ON THE NOSE. Bethlehem meets your specifications exactly on all types of press, drop, and hammer forgings.

Steel

for Strength
... Economy
... Versatility

RAM ADAPTER. This forging weighs 58,780 lb, and measures 140 in. x 73 in. x 25 in.



STEEL CYLINDER for use in 7,500-ton plate stretcher. This forging weighs 171,240 lb, and it's 17 ft, 3 in. long.

GENERATOR SHAFT. Weight, 198,240 lb. As you can tell from these photos, Bethlehem is well-equipped for machining.

REACTOR VESSEL CLOSURE. The OD of this 50,660-lb forging measures 12 ft.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA. *Export Sales:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

FROM THE FILES OF
MANNING, MAXWELL & MOORE

"Cost reduction through modernization of methods and machinery is the keynote of our efforts"

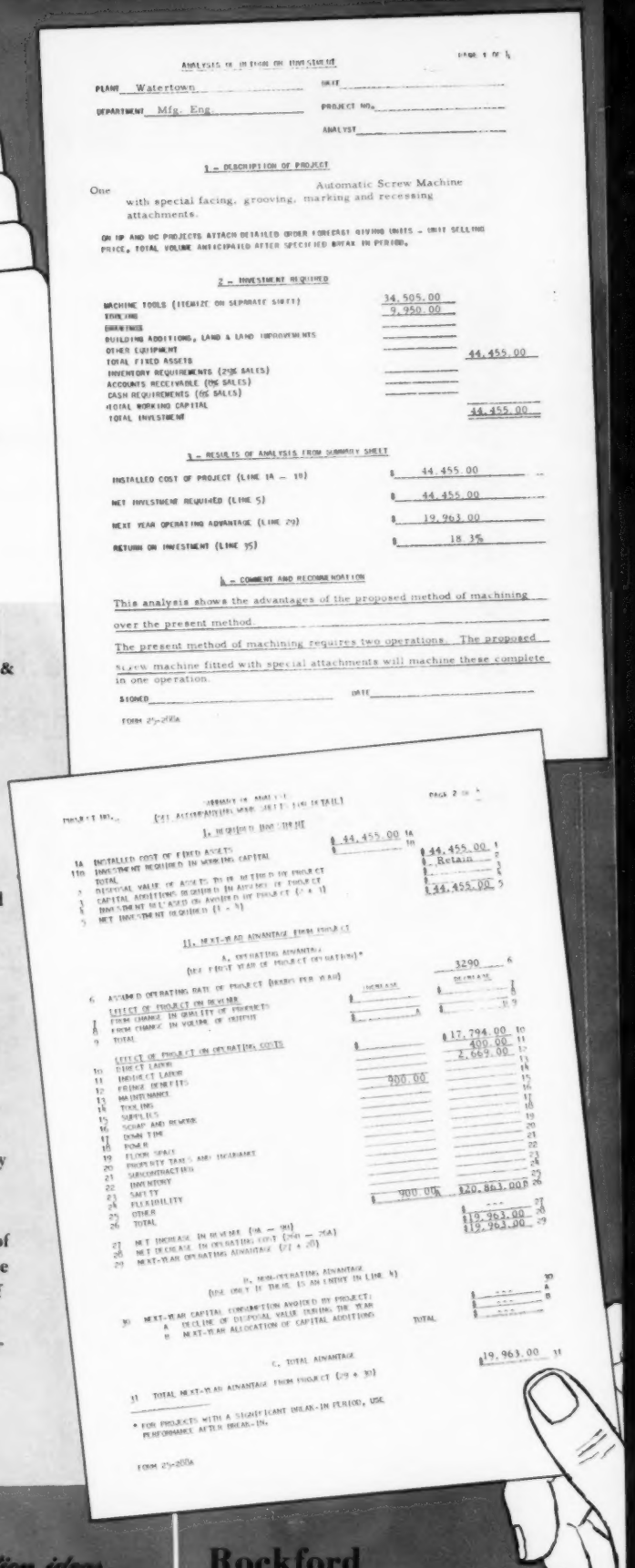
Mr. J. Robert Kelley, President of Manning, Maxwell & Moore, Inc., not only believes in a systematic procedure for equipment replacement, but his company follows through by making use of the MAPI approach to the problem as shown by the sample equipment-analysis forms reproduced here and by Mr. Kelley's statement, which is as follows:

"Manning, Maxwell & Moore, Inc., manufactures and sells to industry "Shaw-Box" Cranes and "Load Lifter" Hoists, "Ashcroft" Gauges, "Consolidated" and "Hancock" Valves, and "American" Instruments. These products are manufactured in five plants — four located in the United States and one in Canada.

"These products are sold in highly competitive industrial markets. To improve or even to maintain a long term competitive position, it has been necessary to continuously review methods and equipment in an effort to combat the inflationary spiral caused by constantly rising labor and material costs. Cost reduction through modernization of methods and machinery is the keynote of our efforts.

"One of the ultimate responsibilities of the chief operating executive is the decision for the allocation of capital funds to provide best for the future needs of the business. The competing demands of the five plants of the company have required some uniform method of presentation to permit analysis and grading in accordance with previously established norms.

"The MAPI Formula applied to facilities replacement answers this requirement."



ANALYSIS OF INVESTMENT

PLANT Watertown — DATE

DEPARTMENT Mfg. Eng. — PROJECT NO.

ANALYST

1 – DESCRIPTION OF PROJECT

One Automatic Screw Machine with special facing, grooving, marking and recessing attachments.

ON RP AND UC PROJECTS ATTACH DETAILED ORDER FORECAST GIVING UNITS – UNIT SELLING PRICE, TOTAL VOLUME ANTICIPATED AFTER SPECIFIED BREAK IN PERIOD.

2 – INVESTMENT REQUIRED

MACHINE TOOLS (ITEMIZE ON SEPARATE SHEET)	34,505.00	
TOOLING	9,950.00	
GAGING		
BUILDING ADDITIONS, LAND & LAND IMPROVEMENTS		
OTHER EQUIPMENT		
TOTAL FIXED ASSETS		44,455.00
INVENTORY REQUIREMENTS (29% SALES)		
ACCOUNTS RECEIVABLE (0% SALES)		
CASH REQUIREMENTS (0% SALES)		
TOTAL WORKING CAPITAL		
TOTAL INVESTMENT		44,455.00

3 – RESULTS OF ANALYSIS FROM SUMMARY SHEET

INSTALLED COST OF PROJECT (LINE 1A – 1B)	$ 44,455.00
NET INVESTMENT REQUIRED (LINE 5)	$ 44,455.00
NEXT YEAR OPERATING ADVANTAGE (LINE 29)	$ 19,963.00
RETURN ON INVESTMENT (LINE 35)	18.3%

4 – COMMENT AND RECOMMENDATION

This analysis shows the advantages of the proposed method of machining over the present method.

The present method of machining requires two operations. The proposed screw machine fitted with special attachments will machine these complete in one operation.

SIGNED — DATE

FORM 25-200A

SUMMARY OF ANALYSIS (SEE ACCOMPANYING WORK SHEETS FOR DETAIL)

PROJECT NO.

1. REQUIRED INVESTMENT

1A	INSTALLED COST OF FIXED ASSETS	$ 44,455.00 1A	
1B	INVESTMENT REQUIRED IN WORKING CAPITAL	$ 1B	
1	TOTAL		$ 44,455.00 1
2	DISPOSAL VALUE OF ASSETS TO BE REPLACED BY PROJECT		$ Retain 2
3	CAPITAL ADDITIONS REQUIRED IN ADVANCE OF PROJECT		$ 3
4	INVESTMENT RELEASED OR AVOIDED BY PROJECT (2 + 3)		$ 4
5	NET INVESTMENT REQUIRED (1 – 4)		$ 44,455.00 5

II. NEXT-YEAR ADVANTAGE FROM PROJECT

A. OPERATING ADVANTAGE (SEE FIRST YEAR OF PROJECT OPERATING)*

6 ASSUMED OPERATING RATE OF PROJECT (HOURS PER YEAR) — 3290 6

		INCREASE	DECREASE	
7	EFFECT OF PROJECT ON REVENUE FROM CHANGE IN QUALITY OF PRODUCTS	$ A	$ B	7
8	FROM CHANGE IN VOLUME OF OUTPUT	$ A	$ B	8
9	TOTAL		$ 17,794.00	10
	EFFECT OF PROJECT ON OPERATING COSTS		400.00	11
10	DIRECT LABOR	$	2,669.00	12
11	INDIRECT LABOR			13
12	FRINGE BENEFITS	900.00		14
13	MAINTENANCE			15
14	TOOLING			16
15	SUPPLIES			17
16	SCRAP AND REWORK			18
17	DOWN TIME			19
18	POWER			20
19	FLOOR SPACE			21
20	PROPERTY TAXES AND INSURANCE			22
21	SUBCONTRACTING			23
22	INVENTORY			24
23	SAFETY			25
24	FLEXIBILITY			26
25	OTHER	$ 900.00	$20,863.00	
26	TOTAL		$ ---	27
27	NET INCREASE IN REVENUE (9A – 9B)		$19,963.00	28
28	NET DECREASE IN OPERATING COST (26B – 26A)		$19,963.00	29
29	NEXT-YEAR OPERATING ADVANTAGE (27 + 28)			

B. NON-OPERATING ADVANTAGE (USE ONLY IF THERE IS AN ENTRY IN LINE 4)

30	NEXT-YEAR CAPITAL CONSUMPTION AVOIDED BY PROJECT: A DECLINE OF DISPOSAL VALUE DURING THE YEAR		$ --- A
	B NEXT-YEAR ALLOCATION OF CAPITAL ADDITIONS	TOTAL	$ --- B

C. TOTAL ADVANTAGE — $19,963.00 31

31 TOTAL NEXT-YEAR ADVANTAGE FROM PROJECT (29 + 30)

* FOR PROJECTS WITH A SIGNIFICANT BREAK-IN PERIOD, USE PERFORMANCE AFTER BREAK-IN.

FORM 25-200A

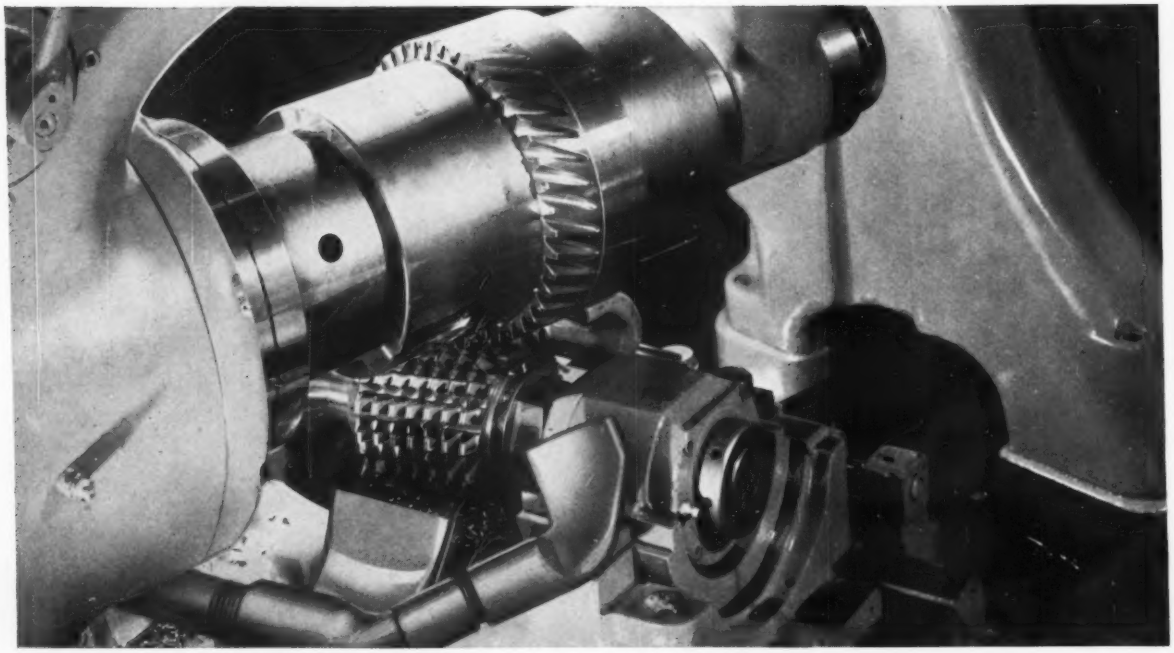
Keep gathering metal-working production ideas... be well informed when you replace machinery...

April, 1961

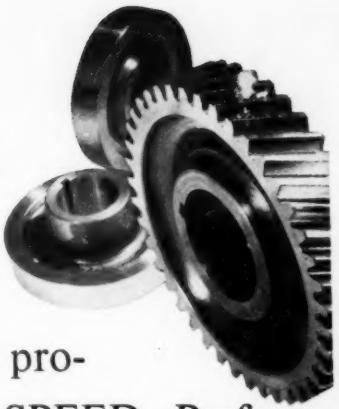
Rockford Insert Group

NEW WAYS TO SPEED PRODUCTION OF HIGH-QUALITY COARSE-PITCH GEARS This Barber-Colman No. 14-15 hobbing machine is FAST. It produces two 6 D.P., 41-tooth helical gears (1-1/2 face) in 3 minutes, 50 seconds. Finish and lead accuracy are excellent. It takes a machine with plenty of capacity, rigidity, and precision to combine this kind of accuracy with high production. Here's how. Bayonet-lock hydraulic tooling, antifriction spindle bearings, and optional DUAL-FEED all slash important seconds from the cutting cycle. Speed of the 5-in. dia hobs, which have three starts and 20 flutes, is 313 rpm. Although index speed is high, generating

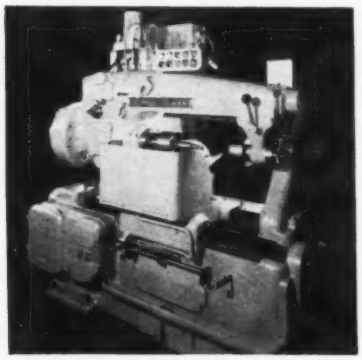
PRODU



CENTER OF MACHINE-TOOL EXCELLENCE **ROCKFORD, ILLINOIS, U.S.A.**



flats are minimized by the number of teeth cutting. "Roughing" feed of .080 ipr shortens the approach cycle. When the hob reaches full depth, feed drops automatically to .045 ipr for finishing. Thus, excellent finish is produced at MAXIMUM SPEED. Performance like this is what makes the Barber-Colman No. 14-15 America's leading coarse-pitch hobber. Its superiority can be measured in economy, versatility, capacity, and accuracy . . . as well as in convenience,



CTIVITY

service, quality, and productivity. And this Dual-Feed model is just one of several important new concepts you can see demonstrated in a visit to our TEST CENTER.

Your Barber-Colman representative will make all the arrangements.

BARBER-COLMAN COMPANY

BARBER COLMAN

42 LOOMIS STREET

ROCKFORD, ILLINOIS

CITY OF MACHINE-TOOL SPECIALISTS **ROCKFORD, ILLINOIS, U.S.A.**

Three reasons why Mattison's new horizontal-spindle surface grinders can hog off more stock . . . faster . . . do toolroom work at production rates.

New sensitivity. Improved system of column ways and gibbing allows smoother, more accurate wheel-head positioning.

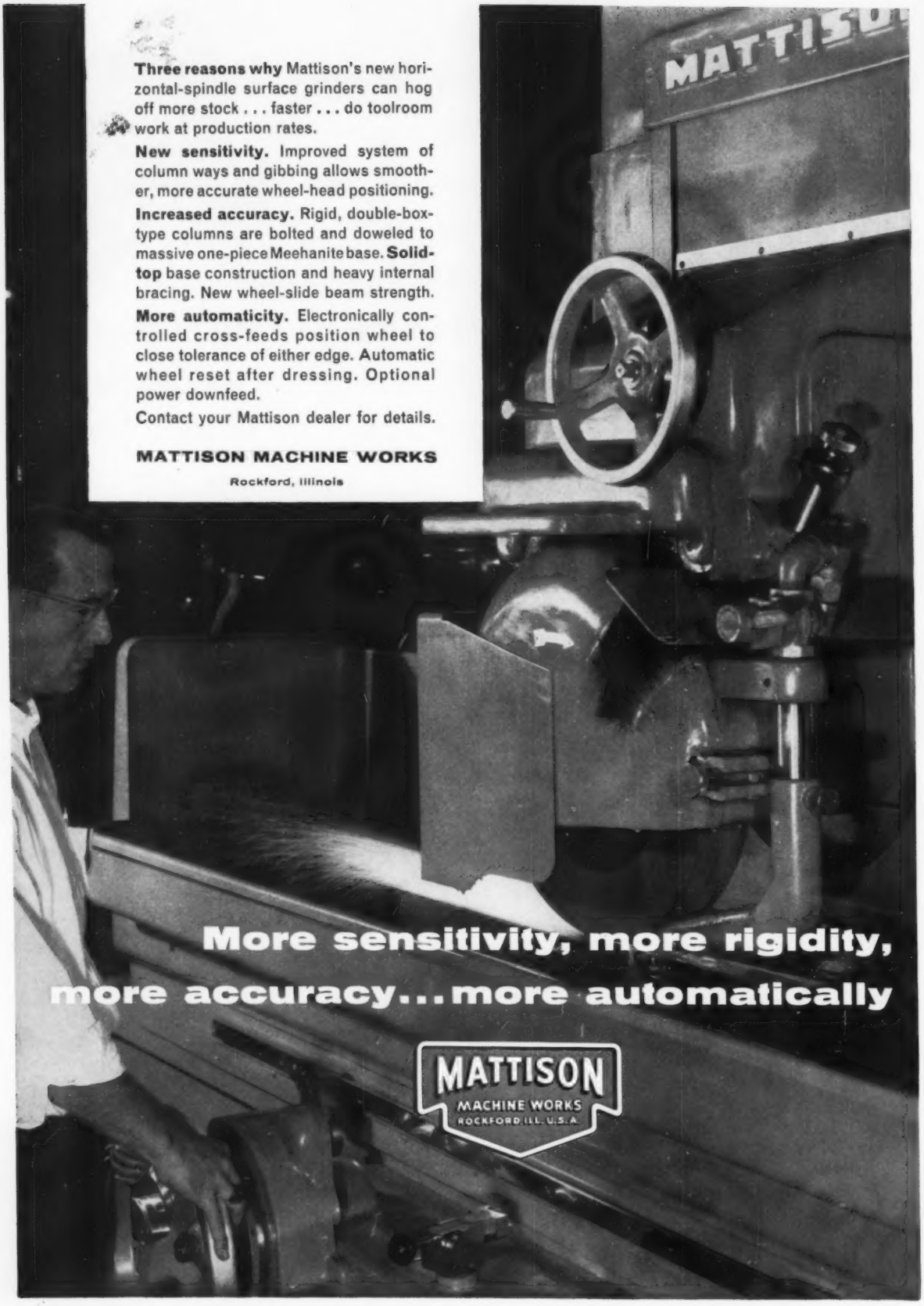
Increased accuracy. Rigid, double-box-type columns are bolted and doweled to massive one-piece Meehanite base. **Solid-top** base construction and heavy internal bracing. New wheel-slide beam strength.

More automaticity. Electronically controlled cross-feeds position wheel to close tolerance of either edge. Automatic wheel reset after dressing. Optional power downfeed.

Contact your Mattison dealer for details.

MATTISON MACHINE WORKS

Rockford, Illinois

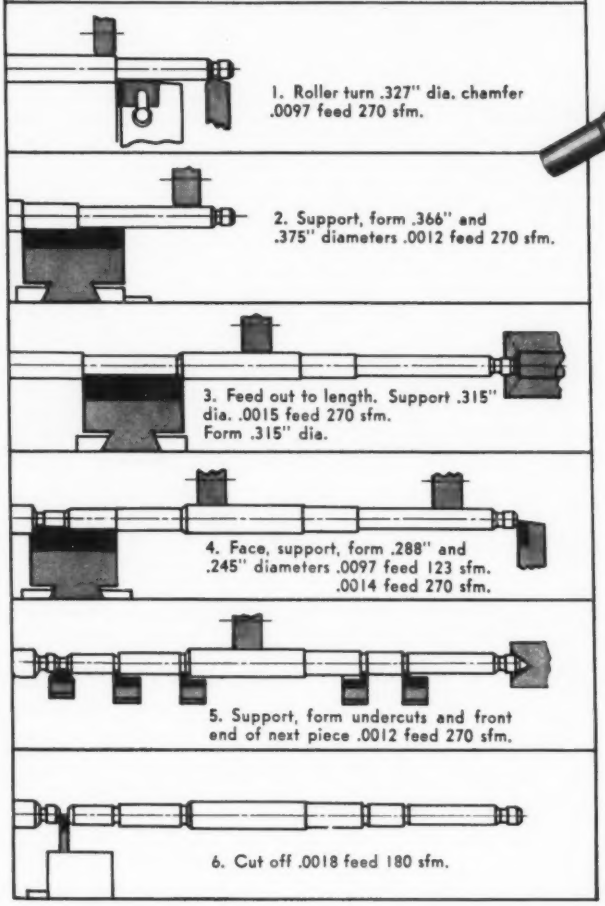


CENTER OF MACHINE-TOOL EXCELLENCE **ROCKFORD, ILLINOIS, U.S.A.**

GREENLEE AIR-FEED AUTOMATICS BENEFIT "ELECTROLUX" FOUR WAYS . . .

MACHINE . . . 1"-6 Automatic Bar Machine Air-Feed — Feedout on index and in 3rd position during machine cycle.
TOOLING . . . Carbide Tipped
MATERIAL . . . 1137
STOCK SIZE . . . 13/32" rd.

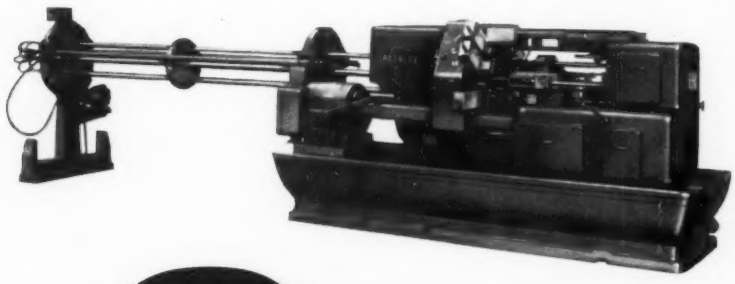
TOOL SLIDE STROKE . . 1-9/16" at .0097" feed.
SPINDLE SPEED . . . 2540 rpm 270 sfm.
MACHINE TIME . . . 5.8 seconds.
ESTIMATED GROSS PRODUCTION . . . 620 per hour


1. Roller turn .327" dia. chamfer .0097 feed 270 sfm.
2. Support, form .366" and .375" diameters .0012 feed 270 sfm.
3. Feed out to length. Support .315" dia. .0015 feed 270 sfm. Form .315" dia.
4. Face, support, form .288" and .245" diameters .0097 feed 123 sfm. .0014 feed 270 sfm.
5. Support, form undercuts and front end of next piece .0012 feed 270 sfm.
6. Cut off .0018 feed 180 sfm.

1. Eliminate stock pushers . . .
2. Eliminate scoring of stock . . .
3. Reduce downtime during set-up . . .
4. Provide extra length feed-out . . .

The part is a 6-7/8" long armature shaft used in the "Electrolux" vacuum cleaner. It demonstrates how effectively Greenlee Air-Feed Automatics and carbide tooling can team-up to increase production and reduce costs. The shaft is machined from 13/32" S.A.E. 1137 steel at a gross production rate of 620 pieces per hour. Recommended cutting speed for high speed tooling is 120 sfm. The rate was boosted to 270 sfm with carbide-tipped tooling. Sequence of operations is shown at the left.

Note how the stock is partially fed out on the index and to its full length in the third position. This provides for the most effective tooling arrangement. Greenlee Air-Feed Automatics permit greater job versatility and assure added profits. See your Greenlee representative or send us a print of your high-cost problem-part.



Write for your copy of Catalog A-405

PRODUCTION MACHINERY

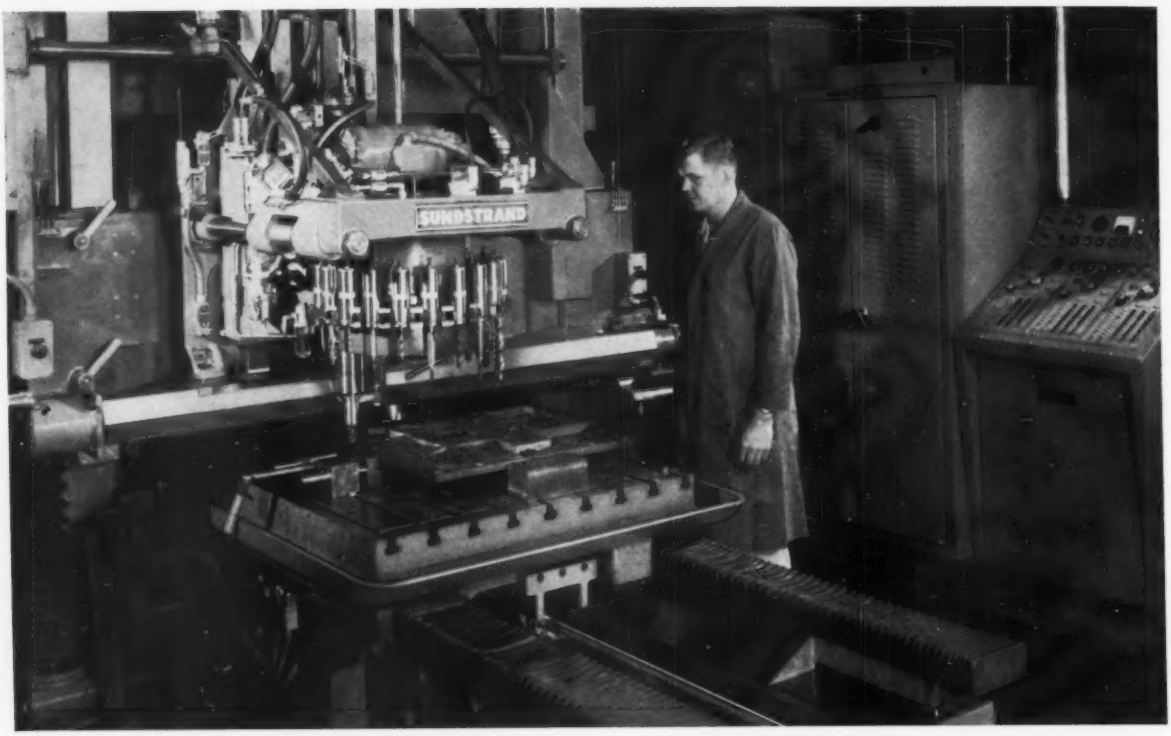
GREENLEE BROS. & CO.

SINCE 1863

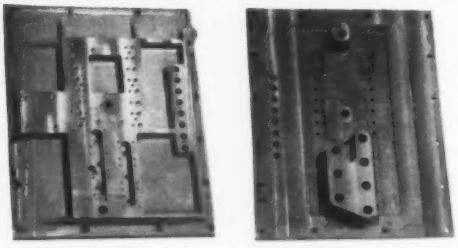
1975 MASON AVENUE
ROCKFORD, ILLINOIS

COMMERCIAL CASTINGS
TRANSFER MACHINES • SPECIAL MACHINES • AUTOMATIC BAR MACHINES • WOODWORKING MACHINES AND TOOLS • DIE CASTING MACHINES • TRIM PRESSES • HYDRAULIC AND HAND TOOLS

FOR PRODUCTION MACHINE TOOLS IT'S **ROCKFORD, ILLINOIS, U.S.A.**



260 operations performed in one-fifth the time by Sundstrand numerically controlled machine with automatic tool changer



Nineteen tools perform over 260 drilling, chamfering, counterboring, tapping, reaming and slot milling operations on top and bottom of part in 3-1/2 hours compared to 17-1/2 hours by previous method.

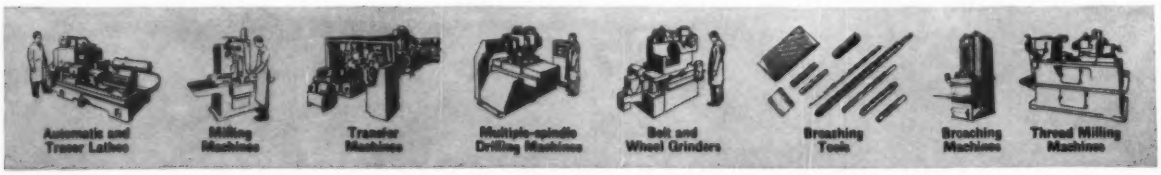
The broad range of Sundstrand N. C. machines is shown in bulletin NC-626. Write for your copy. Included is information on Sundstrand's complete line of key driven drill drivers, tap holders, end mill holders, adjustable boring bars all designed to fit or interchange with any Sundstrand Numerically Controlled Machine or automatic tool changer.

The parts illustrated at the left typify the range of work on which dramatic cost reductions can be achieved by the Sundstrand Model 21 automatic tool change machine with 66½" x 44" table working surface. Over 260 drilling, chamfering, counterboring, tapping, reaming, and slot milling operations were performed in 3½ hours as compared to 17½ hours by the old method.

The Model 21 is available with either a single-spindle rail-mounted head or with optional 20-position tool changer for drilling, boring, reaming, tapping, and light milling. Tools up to 3" diameter are selected, loaded in the spindle, and replaced automatically.

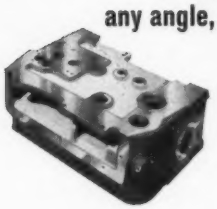
The machine is available with either positioning or contouring control, providing almost unlimited versatility on an exceptionally wide range of work.

Demonstrations can be arranged upon request.

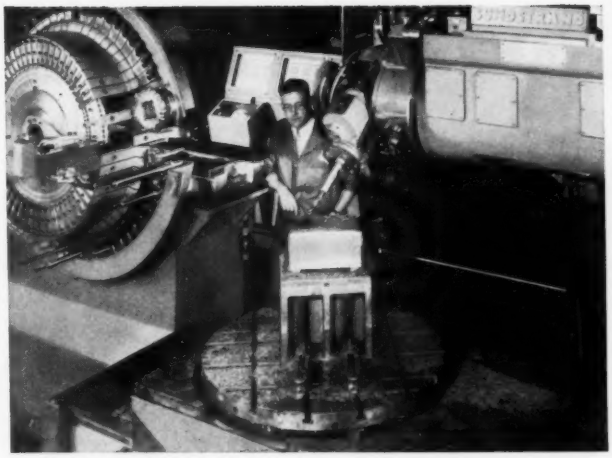


MACHINES DESIGNED TO MEET YOUR NEEDS **ROCKFORD, ILLINOIS, U.S.A.**

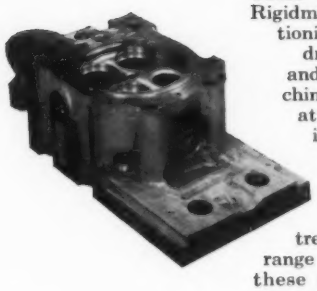
5-axis NC Omnimil machines at any angle, saves set-ups and handling



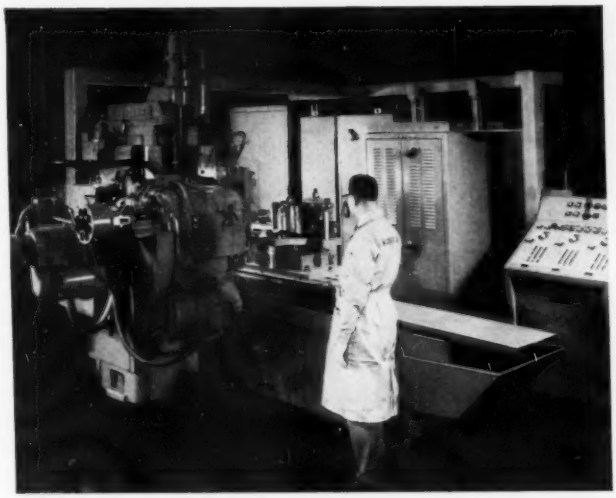
Single machine "production line" that mills, drills, bores, reams, taps all exposed faces of the workpiece at any angle —machines many parts in a single set-up — reduces handling of workpiece to improve accuracy. Made in two sizes, the 15 hp Model OM-3 has 48″ X-Y-Z axial movements, 42″ dia. rotary table, and optional automatic tool changer. The 40 hp OM-4 has 96″ X and Y and 72″ Z axial motion, with 58″ dia. rotary table. A pendant controlled power-assist for changing heavy tools is optional.



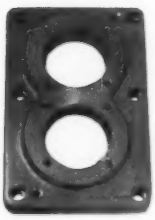
3-axis NC horizontal machines speed multiple operations on a wide range of parts



These are basic Sundstrand Rigidmils with numerical positioning control for milling, drilling, boring, reaming, and tapping. Ideal for machining long parts, one side at a time, or with optional index base for machining various faces of parts whose dimensions do not exceed table widths. Extreme versatility and wide range of applications make these machines among the most productive available per dollar of machine investment. Table widths — 18″ to 38″. Table travel — 54″ to 216″.



3-axis NC turret-type machine drills, taps, bores, reams automatically

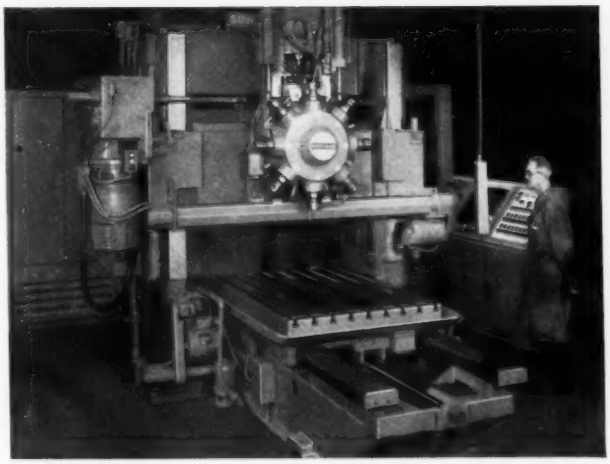


This extremely versatile machine for hole work handles workpieces up to 40″ wide x 60″ long x 30″ high.

All motions, including rotation of the eight-spindle turret can be operated by numerical or manual pushbutton control. Automatic depth control insures accuracies without operator attention.

Machine is also available with 2-axis control and adjustable stop dogs for depth control.

Ask for literature.



SUNDSTRAND

SUNDSTRAND MACHINE TOOL

BELVIDERE, ILLINOIS • DIVISION OF SUNDSTRAND CORPORATION

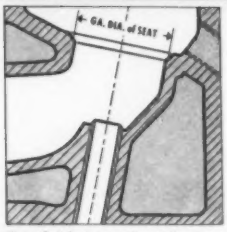
FOR PRODUCTION MACHINE TOOLS IT'S **ROCKFORD, ILLINOIS, U.S.A.**

Requirements:

ACCURACY
CONVENIENCE
DEPENDABILITY

. . . but the high production of a progress-thru machine not demanded of this valve-seat and stem-hole finishing machine

W. F. & John Barnes Special Vertical Valve-Seat and Stem-Hole Finishing Machine, with 2-position rotary table, manually loaded. Equipped with Barnes dual-type precision spindles, having facing and gun-boring tools. Inner spindle for stem hole, outer spindle for seat. Production 34 parts per hour gross.



Fine finish to precise tolerances eliminates reaming operations. Concentricity of guide hole and gauge diameter of valve seat is held to .0005" total indicator reading.

The requirements of the customer placed emphasis on accuracy, ease of operation, and dependability; but high-speed production was not demanded. As a result, this finishing machine has met all requirements and has proved to be a very profitable investment. Its continuous accuracy and the fine finish it produces as a result of the tooling method eliminates the need for reaming or other final finishing operations. And for this type of machine, its production is very high.

Where production demands do not exceed the limits of this compact unit, adaptations can be made to handle all types of valve jobs on small or large cylinder heads. When higher production is required, a W. F. & John Barnes Progress-Thru type of transfer machine will provide it and with very high efficiency. But regardless of your requirements, Barnes' broad experience assures you of receiving a fine machine with all the cost-cutting features of the most modern equipment.

Ask for an Analysis of Your Machining Methods

W. F. & JOHN BARNES

Builders of Better Machines Since 1872.

W. F. & JOHN BARNES COMPANY

402 SOUTH WATER STREET • ROCKFORD, ILLINOIS

Barnes engineers are ready to work with you to improve production methods and cut machining costs. Write for descriptive literature.

MULTIPLE-SPINDLE DRILLING, BORING, TAPPING MACHINES • AUTOMATIC PROGRESS-THRU TRANSFER-TYPE MACHINES

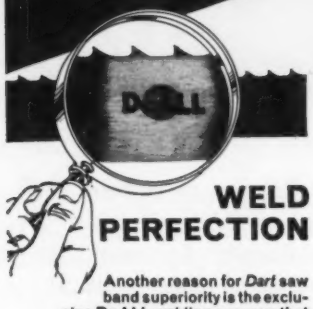
MACHINES DESIGNED TO MEET YOUR NEEDS **ROCKFORD, ILLINOIS, U.S.A.**

Another star in DoALL's galaxy of new saw blades...

The Dart®

guaranteed to outperform any other carbon steel saw band or

your money back!



WELD PERFECTION

Another reason for *Dart* saw band superiority is the exclusive DoALL welding process that guarantees the strongest saw band weld made—and perfectly matched teeth. *Dart* blades are sold in custom welded lengths—ready for use on your machines. Set is guaranteed to be accurate within ± .002 in. and to be perfectly balanced for long, accurate service.

ATTENTION . . . CUT-OFF SAW USERS

Here's good news for all operators of band sawing machines using carbon steel blades. The new *Dart* saw band is engineered to outperform any and every other make of carbon steel saw bands. Why? Only *Dart* has the specialized heat-treatment that gives it a spring-tempered back with a full hard cutting edge. Only *Dart*, created by the finest saw band making know-how in the entire industry, has the cutting ability, accuracy and life you want to cut sawing costs.

Try the new *Dart* saw band without delay. Remember: If it doesn't cut more accurately and longer than any other carbon steel blade, *you'll get your money back.* Call your local DoALL Sales-Service Store today.

SB-85

This is a typical DoALL Store

The DoALL Company, Des Plaines, Illinois

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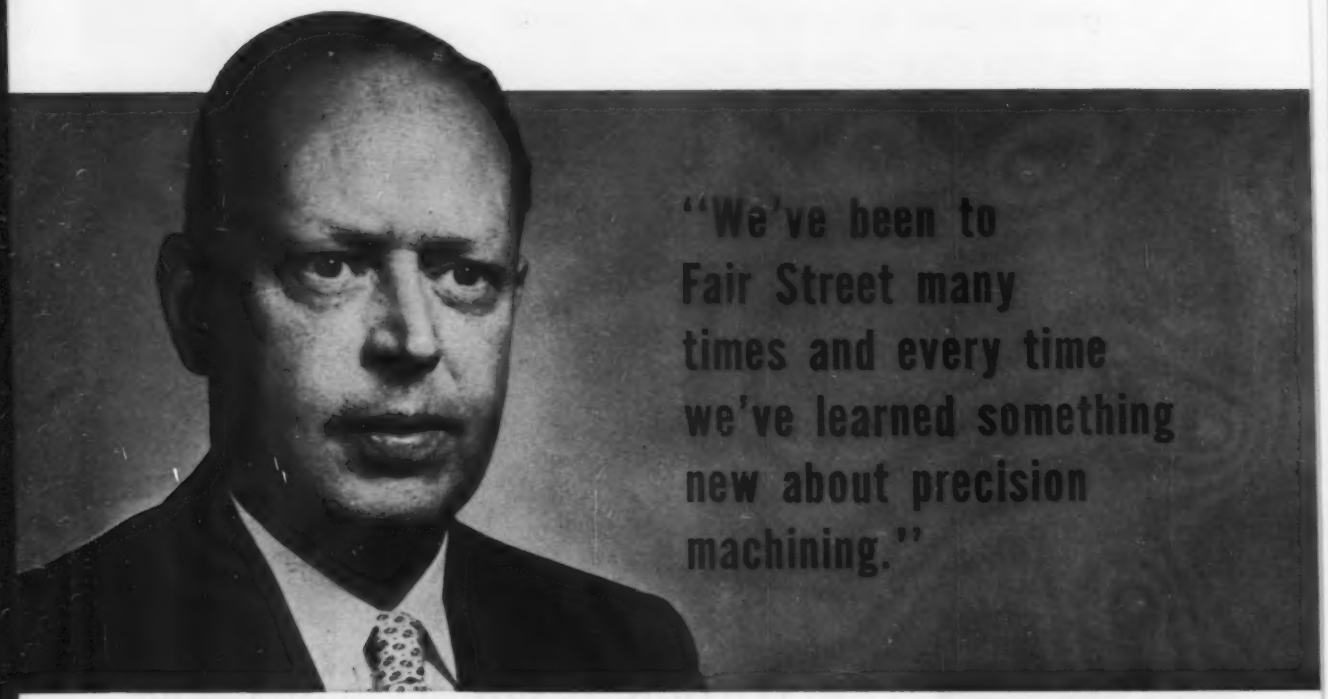
OLIVER H. TRAGGE, President
Tragge Boring Company

a man who came to Fair Street



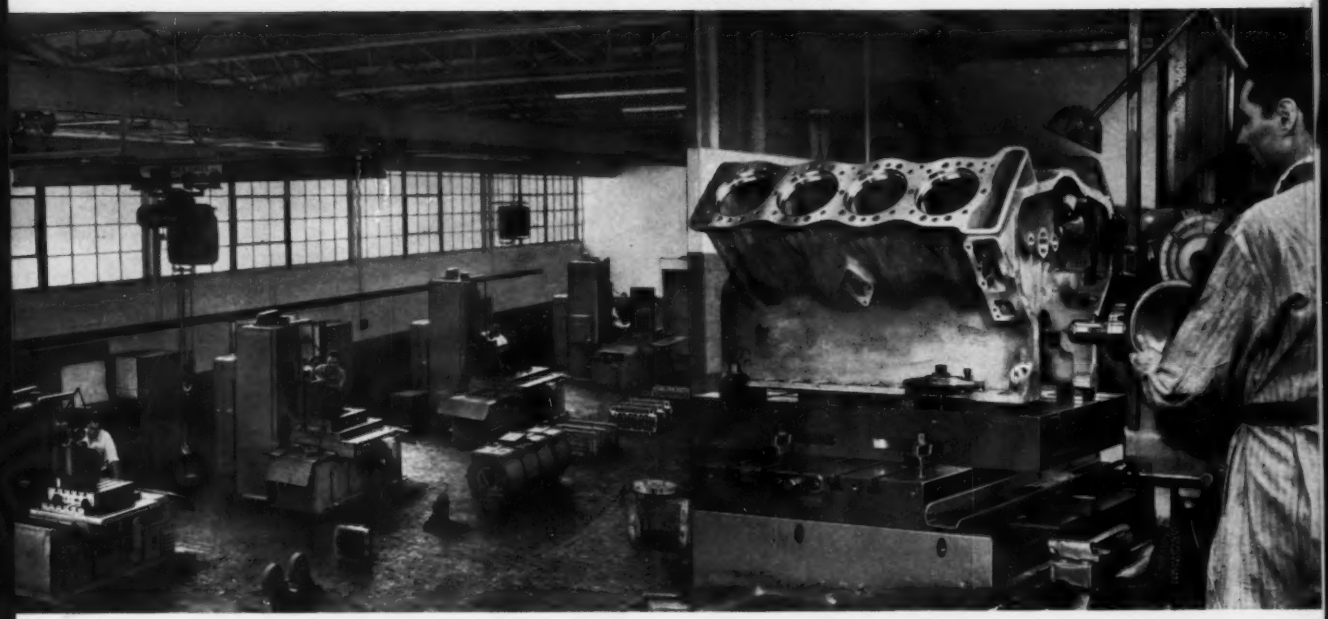
"During the course of buying four DeVlieg JIGMILS over a period of six years, we've been to Fair Street many times. Every visit has been an introduction to something new, not only in the development of the JIGMIL, itself, but also in the DeVlieg philosophy of precision machining and tooling. Of our four JIGMILS, the first was purchased as the direct result of a visit to Fair Street. From then on the JIGMILS sold themselves. Whenever business volume warranted, we added a new one. We honestly feel that the efficiency, accuracy and economy of the JIGMIL technique of jigless machining has been a big factor in the very favorable competitive position that our company has enjoyed in the past few years."

OLIVER H. TRAGGE

DE VLIEG MACHINE COMPANY, FAIR STREET • ROYAL OAK, MICHIGAN

SOME OF OUR JIGMIL USERS

AFC Industries, Inc.
Air Reduction Co., Inc.
Alliance Tool & Machine Co.
Amco Incorporated
Bendix Corp.
Besly Welles Corp.
Bethlehem Steel Co.
Burg Tool Mfg. Co.
Buhr Machine Tool Co.
Cessna Aircraft Co.
Cross Company
Farrel-Birmingham Co., Inc.
Gardner-Denver Co.
Gardner Machine Company
Goulds Pumps, Inc.
Harnischfeger Corp.
Hill Machinery Co.
Homogenette Inc.
Hoover Tool & Die Co.
Hyster Co.
Ideal Tool & Mfg. Co.
Lake Erie Machinery Corp.
Leesona Corp.
Marion Power Shovel Co.



Mason, Shaver & Rhoades Inc.
Midwest Machine & Mfg. Co.
National Electrical Welding Machines Co.
National Mine Service Co.
New Deal Tool & Machine Co.
Paramount Boring & Machine Co.
Paul Machine Tool & Die Works
Quality Tool and Die Co.
R & B Tool Company
Rochester Products Div., GMC
Saginaw Steering Gear Div., GMC
Snyder Corp.
Standard Tool Co.
Vard Div., Royal Industries Inc.
Vogt, Henry Machine Co.

STANDARD JIGMILS DO THE JOB

Shown above are the four standard DeVlieg JIGMILS installed at Tragge. Standard JIGMILS, such as these with Duplitrol automatic positioning and end measuring rods, are designed for "jigless boring," milling, drilling, tapping and reaming to precise limits of accuracy. Close-up view, above right, is of a standard model 3-B JIGMIL boring holes in a V-8 engine block at Tragge.

WILL YOU BE THE NEXT TO VISIT FAIR STREET

OUR NEWEST CATALOG WILL HELP YOU DECIDE. MAY WE SEND IT?

DeVlieg
SPIRAMATIC JIGMILS®

ACCURATE HOLES AND FLAT SURFACES IN PRECISE LOCATIONS

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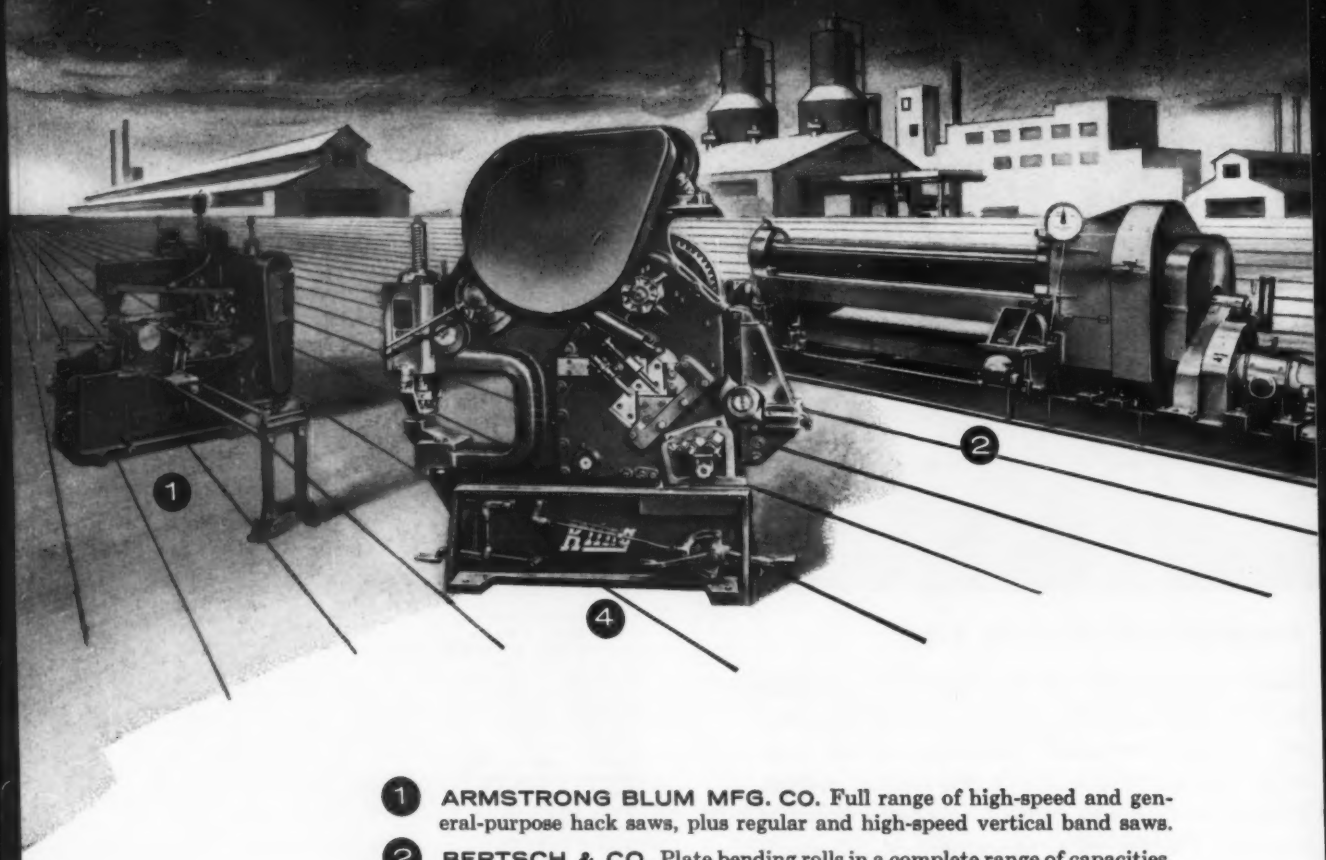
5 REASONS WHY RYERSON IS . . . .

your most complete source



1. **ARMSTRONG BLUM MFG. CO.** Full range of high-speed and general-purpose hack saws, plus regular and high-speed vertical band saws.
2. **BERTSCH & CO.** Plate bending rolls in a complete range of capacities, and overdriven squaring shears for material from 10 gauge to 1¼" thick. Also straightening rolls and culvert-making machines.
3. **DREIS & KRUMP MFG. CO.** Mechanical and hydraulic press brakes from 11- to 2000-ton capacity. Also full line of hand and power apron brakes, straight side presses, and special bending machines.
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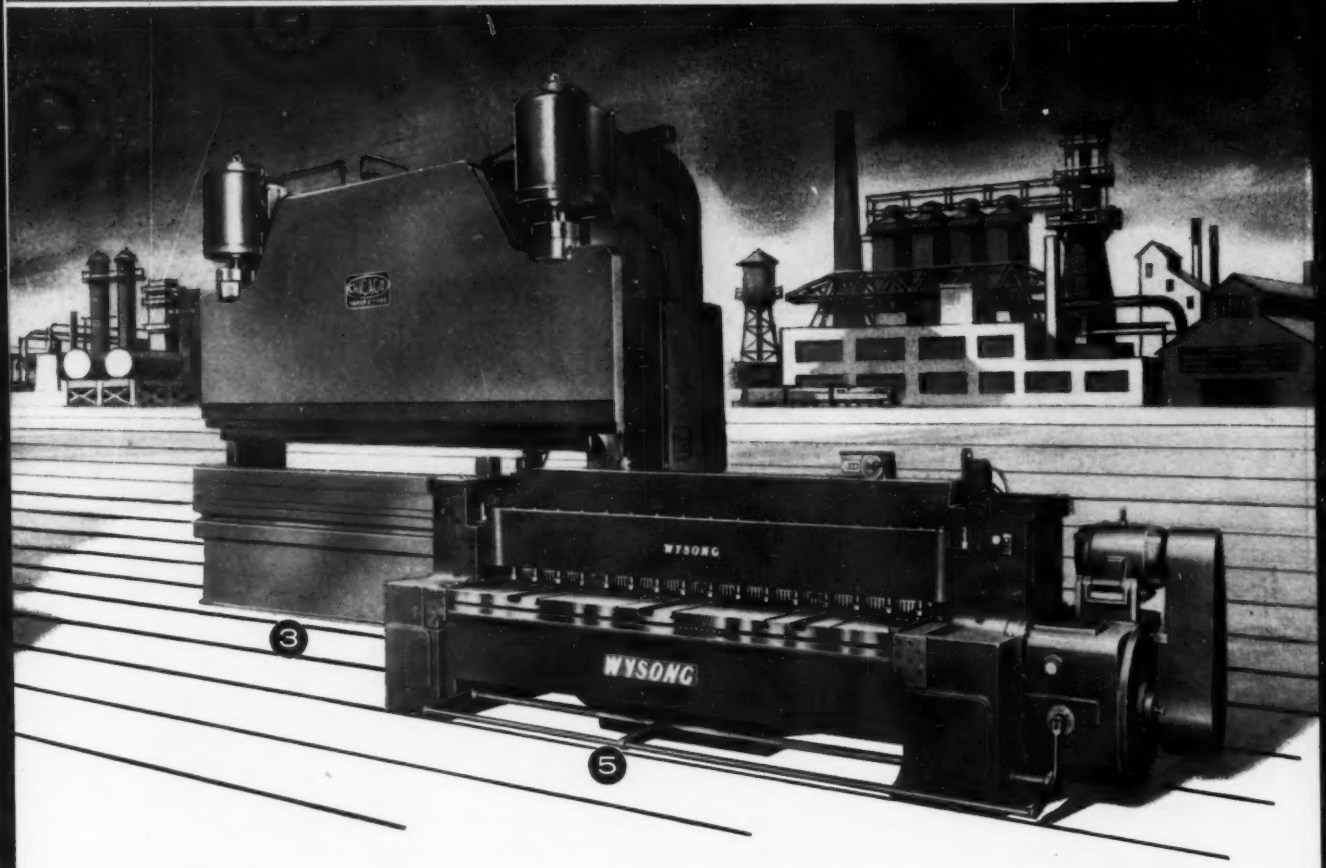
5. **WYSONG AND MILES CO.** Underdriven squaring shears for material from 18 gauge to ½" thick, also sheet metal rolls.

for metalworking machinery



No other single supplier of machinery for metal fabrication can offer you the range of types and models available from Ryerson. So, with no other supplier can you be so sure of getting exactly the right machine to do each fabricating job best at lowest cost.

We represent nearly 100 manufacturers, each a recognized leader in its field. The five featured on these pages represent five good reasons why it will pay you to call in a Ryerson representative when you're considering a machinery purchase. His recommendations are backed by Ryerson experience gained in supplying metal *and* the machinery to fabricate it for over a century.

Our complete line includes equipment for bending, braking, forming, hoisting, drilling, pressing, punching, rolling, sawing, shearing, threading and welding.

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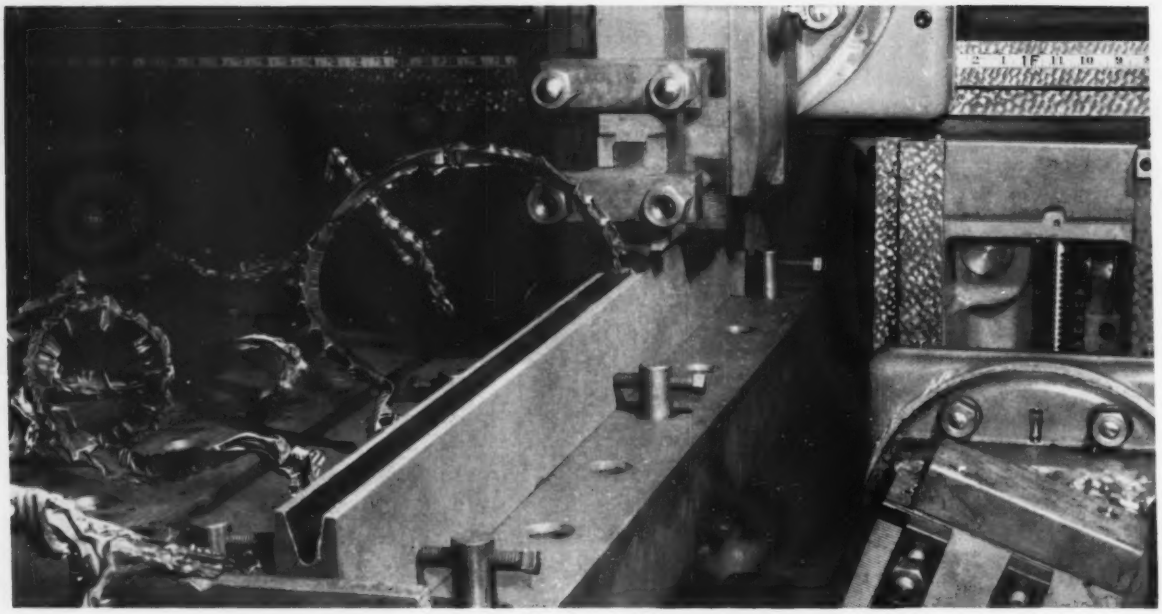
STEEL · ALUMINUM · PLASTICS · METALWORKING MACHINERY

It's easy to use...

CARBIDE TOOLS EFFICIENTLY



on RMT shaper-planers

- Hydraulic Drive Absorbs Shock to Carbide Tools
- Maximum Strokes Per Minute Possible — acceleration and deceleration provided within short table travel through hydraulic power
- Hydraulic Pressure Holds Steady Cutting Speed at Rate Selected

These efficiency factors also provide lower-cost operation!

Fast Set Up — Quick To Respond — complete control of machine directly from operator's position.

Any Cutting Speed is Readily Obtained.

Feeds Are Infinitely Adjustable Throughout Specified Range.

Full Speed at Peak HP Reached More Quickly with Hydraulic Power.

Get Full Details and Specifications
Write Dept. M461

ROCKFORD MACHINE TOOL CO., ROCKFORD, ILLINOIS

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WEATHER
Fair, Mild

T-J
TOMKINS-JOHNSON TRIBUNE

★★★★★
FINAL

THE TOMKINS-JOHNSON CO. • 2425 W. Michigan Ave. • Jackson, Michigan

INCREASED PRODUCTION... CREATES PRICE ADJUSTMENT on T-J Squair Head Cylinders

JACKSON, MICH. JAN. 3 (TP)—"Due to the tremendous initial response and the continuing acceptance and purchase of the new Tomkins-Johnson Squair Head Cylinders, it has been possible to *lower* the basic price," according to T-J personnel. In effecting this price cut, Tomkins-Johnson has again proven that acceptance of a quality product and the inevitable increase in manufacturing volume *CAN* economically justify a price reduction *WITHOUT* jeopardizing quality.

The T-J Squair Head Cylinder, an interchangeable air cylinder for any pneumatic power application, was first introduced by Tomkins-Johnson in 1958. It was an immediate success because of its availability in a wide range of bore sizes and strokes . . . as well as the standard quality features, including the new T-J Super-Cushion for air cylinders.

Other Standard Features

Other standard T-J features that allow the T-J Squair Head Cylinder to retain its high quality comparison over other makes of air cylinders and still give you lower price are; solid steel heads and mounting plates, hard-chrome plated bodies and piston rods, leak-proof cylinder head to body construction, heavy duty, high tensile ground and polished chrome, plated piston rod, and many more . . . STANDARD AT NO EXTRA COST.

Tomkins-Johnson, by virtue of the announced lower cost on its Squair Head Cylinder, wish to thank their customers for their initial acceptance which has been such a contributing factor in this price reduction.

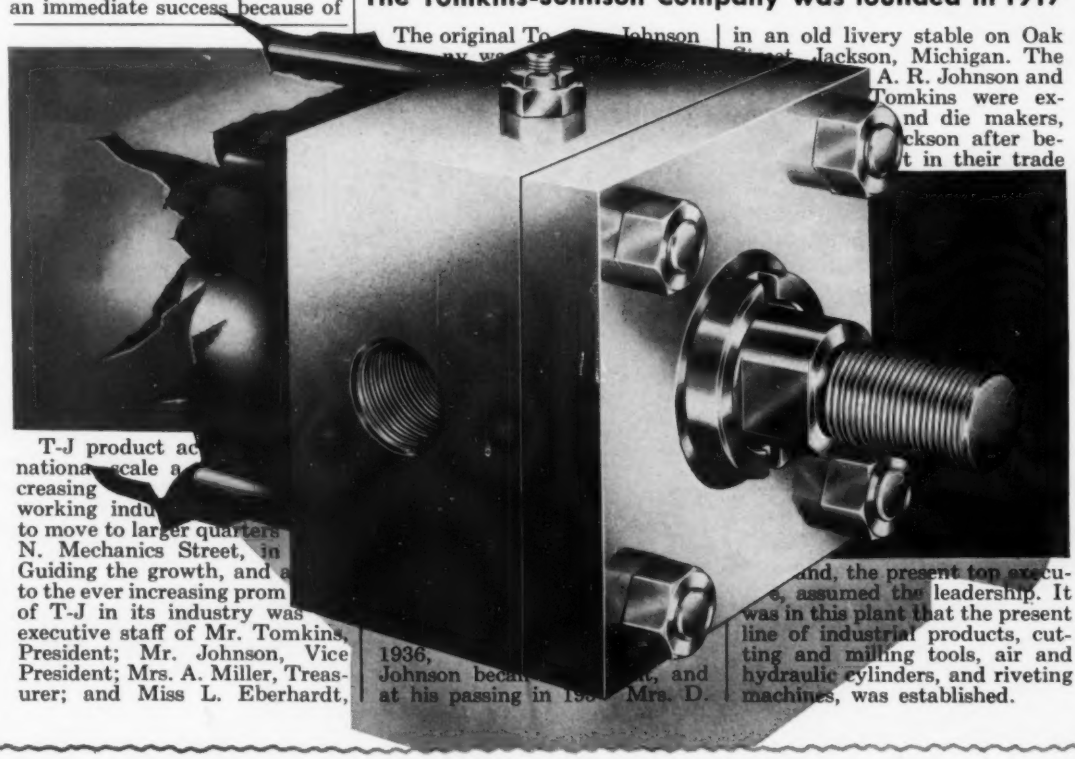
T-J Produces Complete Line

Tomkins-Johnson also produces a complete line of hydraulic and pneumatic cylinders for *EVERY* power drive application . . . including the very popular Spacemaker. If you need further information or complete catalog material, write T-J direct, or request it from your T-J sales representative.

The Tomkins-Johnson Company was founded in 1917

The original To Johnson

in an old livery stable on Oak Jackson, Michigan. The A. R. Johnson and Tomkins were ex- nd die makers, ckson after be- t in their trade



T-J product ac
nationa scale a
creasing
working indu
to move to larger quarters
N. Mechanics Street, in
Guiding the growth, and a
to the ever increasing prom
of T-J in its industry was
executive staff of Mr. Tomkins,
President; Mr. Johnson, Vice
President; Mrs. A. Miller, Treasurer; and Miss L. Eberhardt,

1936,
Johnson becam t, and
at his passing in 19 Mrs. D.

nd, the present top execu- assumed the leadership. It was in this plant that the present line of industrial products, cutting and milling tools, air and hydraulic cylinders, and riveting machines, was established.

For more data circle this page number on card at back of book

450* PIECES PER MINUTE!

NOT JUST SPEED ALONE ... BUT SPEED PLUS ...

accuracy of product, rigidity, good tool life, fewer and simple adjustments, lower maintenance!

Have you witnessed production runs of difficult-to-make parts on National High Speed Headers? Observe the many features in machine and tooling. Start now to gain the benefits of sustained production at the highest safe speeds ever achieved!

We welcome you to Tiffin for actual demonstrations and a thorough study of your cold heading requirements.

Ask to see our
16mm color sound film,
"High Speed Cold Heading."

*1/8-inch High Speed Cold Header
27,000 Parts Per Hour*

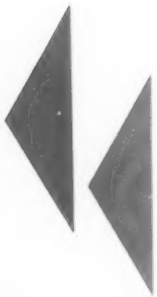
Founded 1874—DESIGNERS and BUILDERS of MODERN FORGING MACHINES • MAXIPRESSES • REDUCEROLLS • COLD HEADERS BOLTMAKERS • NUT FORMERS • TAPPERS • NAILMAKERS CO-PIONEERS WITH INDUSTRY OF ADVANCED METALWORKING PRODUCTION METHODS

HARTFORD DETROIT CHICAGO

NATIONAL MACHINERY CO.

TIFFIN, OHIO, U. S. A.

In any language...
Clearing presses are
the way to more
efficient mass production



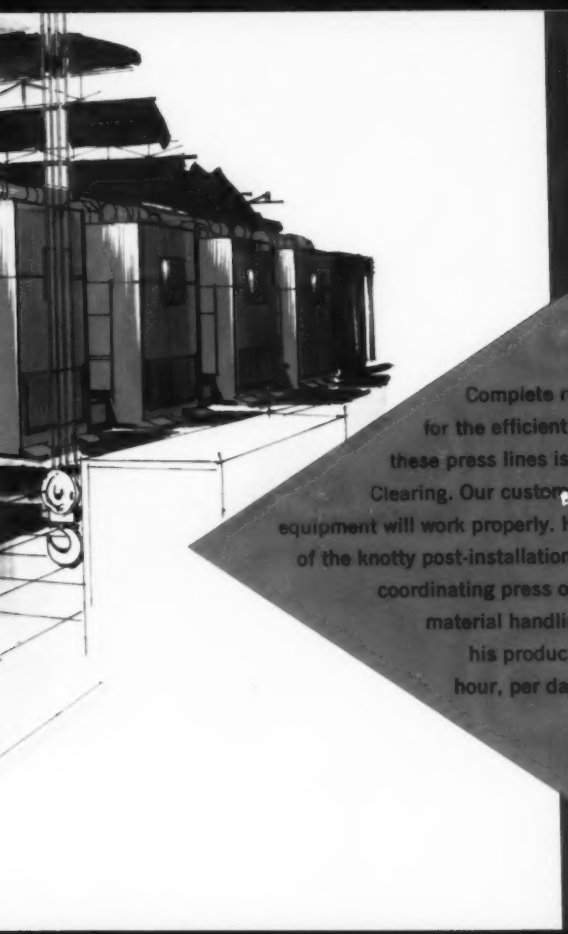
here is the story

クリヤリング・プレスで
生産の飛躍

and this is the result

four press lines like this one... including material handling, automation equipment and dies. The entire system is tested on Clearing's assembly floor.

run, tried and proved before delivery

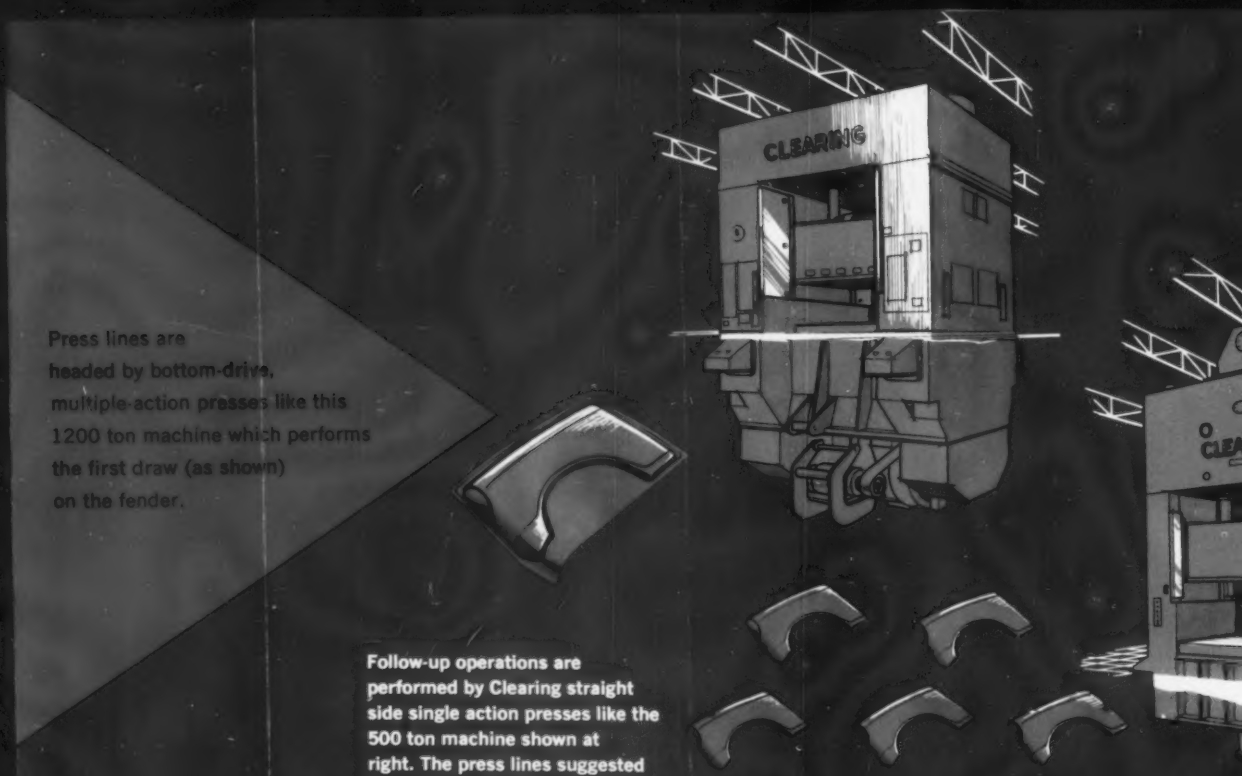


Complete responsibility for the efficient operation of these press lines is assumed by Clearing. Our customer knows the equipment will work properly. He is relieved of the knotty post-installation problems of coordinating press operation with material handling. He knows his production rates per hour, per day, per month.

Press lines are headed by bottom-drive, multiple-action presses like this 1200 ton machine which performs the first draw (as shown) on the fender.

Follow-up operations are performed by Clearing straight side single action presses like the 500 ton machine shown at right. The press lines suggested for producing fender extensions are somewhat lower in capacity.

WHATEVER YOUR PRODUCTION NEEDS

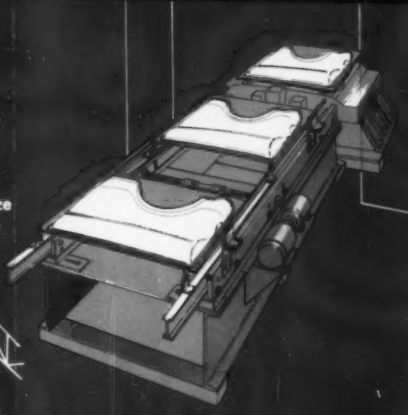


Press lines are headed by bottom-drive, multiple-action presses like this 1200 ton machine which performs the first draw (as shown) on the fender.

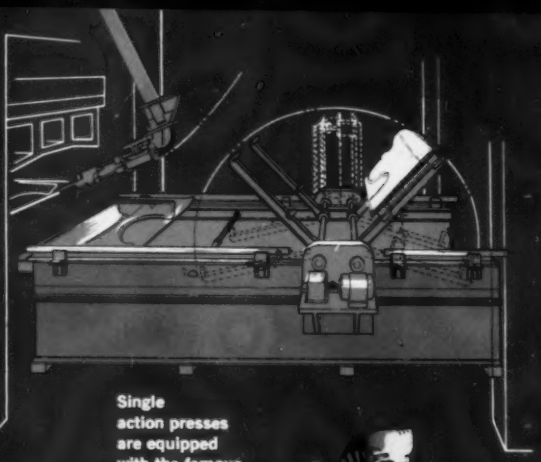
Follow-up operations are performed by Clearing straight side single action presses like the 500 ton machine shown at right. The press lines suggested for producing fender extensions are somewhat lower in capacity.

WHATEVER YOUR PRODUCTION NEEDS . . . AN O.B.I. OR AN ENTIRE MANU

Clearing designed and built automated tables like this for hands-off materials handling between presses. Tables are adjustable so that parts of different size and shape may also be produced.

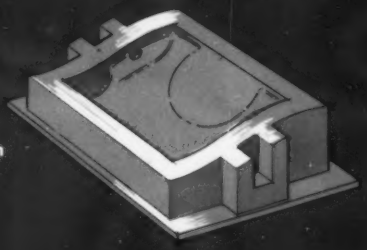


A mechanical unloading arm removes the piece-part after first draw. The part is automatically inverted by this turnover device so that the part goes into follow-up presses right side up.



Single action presses are equipped with the famous Clearing Tornadyne Clutches. Dual speed clutches cut cycling time on multiple action presses.

Responsibility for the fender dies is assumed by Clearing. The dies are designed and built while the presses are being constructed. At target date, the entire system is ready for swift, efficient, profitable production.

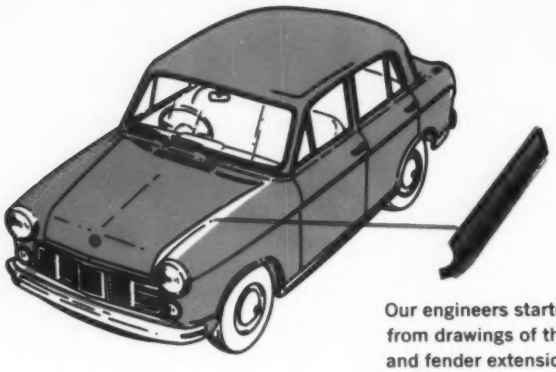


All presses have Clearing's automatic oil lubrication system and many other Clearing exclusive design features.

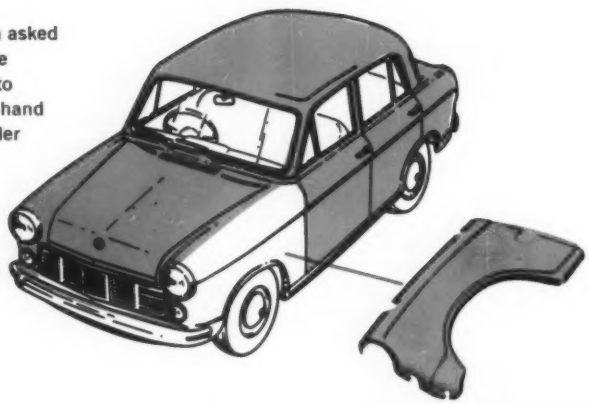
ANUFACTURING SYSTEM, LET CLEARING ENGINEERS HELP YOU FIND A BETTER WAY

WE WERE ASKED TO TACKLE THIS PROBLEM

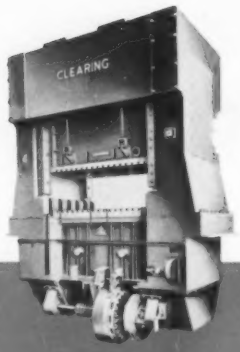
A leading automotive manufacturer in Japan asked Clearing to propose the equipment necessary to produce right and left hand front fenders and fender extensions.



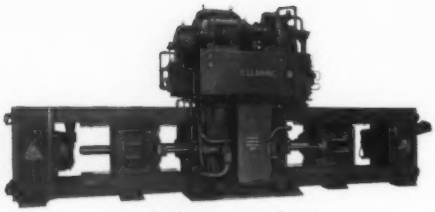
Our engineers started from drawings of the fender and fender extension shown here.



do the job? What type of
t type of in-process handling
These problems were tackled
plans engineering group.



Bottom Drive, multiple action



Special purpose equipment

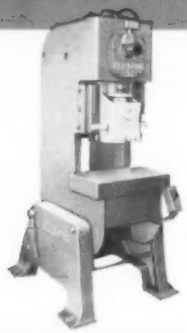
Column-

USI Clearing

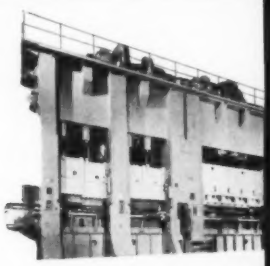
DIVISION OF U.S. INDUSTRIES, INC.
6499 W. 65th Street, Chicago 38, Illinois

Clearing builds all types of press equipment from 22 tons upward. Whatever the problem, let Clearing recommend the equipment that is best for you.

Straight Side Mechanical



Open Back Inclinable



Automated Transfer Presses

BETTER PROFITS THROUGH BETTER TOOLING WITH CARBOLOY® CARBIDE PLUSES

ANNOUNCING THE NEW CARBOLOY® TRACER IN THE ADJUST-O-BREAKER TOOLHOLDER FAMILY

Now you can choose your tracer toolholders with all the cost-cutting advantages of the Carboloy® Adjust-O-Breaker line. The newest addition to the Adjust-O-Breaker line, this tracer toolholder is available in 2 styles and 7 sizes to help you handle more jobs with less tooling.

The exclusive Adjust-O-Breaker design lets you adjust the chipbreaker from any angle . . . offers any desired adjustment within its range . . . features "floating" indexable chipbreaker with absolute repeatability. In addition to the tracers, you can choose from negative rake Adjust-O-Breakers (10 styles, 54 sizes), and positive rake (5 styles, 50 sizes), to meet most of your tooling needs more efficiently and economically.

Check today with your Authorized Carboloy Distributor – or write: *Metallurgical Products Department of General Electric Company, 11147 E. 8 Mile Street, Detroit 32, Michigan.*

CARBOLOY® CEMENTED CARBIDES

METALLURGICAL PRODUCTS DEPARTMENT

GENERAL ELECTRIC

CARBOLOY® CEMENTED CARBIDES • MAN-MADE DIAMONDS • MAGNETIC MATERIALS • THERMISTORS • THYRITE® • VACUUM-MELTED ALLOYS

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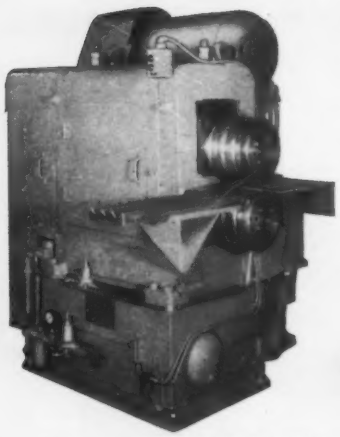


from the forging roll . . .

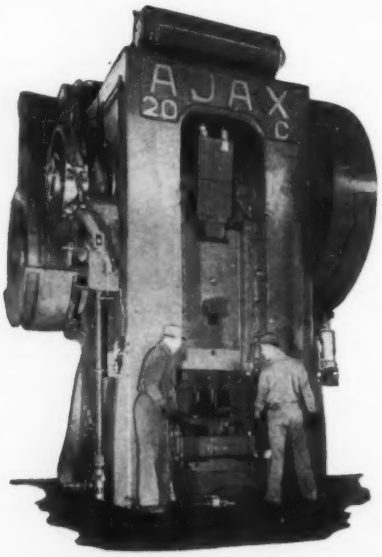
AJAX WIDE ADJUSTMENT FORGING ROLLS

PRE-ROLL YOUR FORGING BLANKS • • •

FOR METAL SAVING • LONGER DIE LIFE • BETTER FIBRE FLOW

AJAX ROLLS are built in seven sizes to pre-roll forging blanks ranging from Connecting Rod blanks to the largest Airplane Propellers. Illustrations show Automobile Connecting Rod blank formed (above) and press-forged (below) on **AJAX HIGH SPEED FORGING PRESS.**

. . . to the forging press



WRITE FOR BULLETIN 91-B

THE Ajax MANUFACTURING COMPANY
EUCLID BRANCH P. O. CLEVELAND 17, OHIO
110 S. DEARBORN ST., CHICAGO 3, ILLINOIS
W. P. WOOLDRIDGE CO. • BURLINGAME, CAL. • LOS ANGELES 22, CAL.

DATA
18 units with 64 spindles
60-inch index table
12 work fixtures

Single Kingsbury combines 64 operations

Cuts cost-per-part, space, banks of parts

One machine, 64 operations, 180 parts per hour gross. All this cuts the cost per part. It saves floor space. It reduces banks of parts in process.

A rate of 180 parts per hour gross means a 20-second time cycle or 18.2 seconds for work. To drill the deep holes in this time we used more than one unit, each drilling part depth.

Extra spindles on the vertical units allowed us to use low-cost standard tools instead of special combination tools.

We rebuilt this machine from equipment the customer returned to us. This saved him money, yet he has the regular Kingsbury new-machine guarantee, plus good basic design and rugged, accurate construction. His machine went right back into his production line because our test runs before shipment guaranteed uniform parts that gaged.

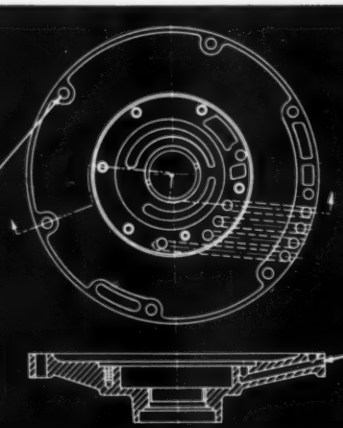
If you'd like to save money in drilling type operations, ask us to quote on a job. Kingsbury Machine Tool Corporation, Keene, N. H.

KINGSBURY

CAST IRON OIL PUMP HOUSING FOR AUTOMATIC TRANSMISSION

9 Vertical Units with 47 Spindles

DRILL – 22 HOLES
C'SINK – 13 HOLES
TAP – 8 HOLES
REAM – 1 HOLE
END MILL – 1 HOLE & 2 NOTCHES

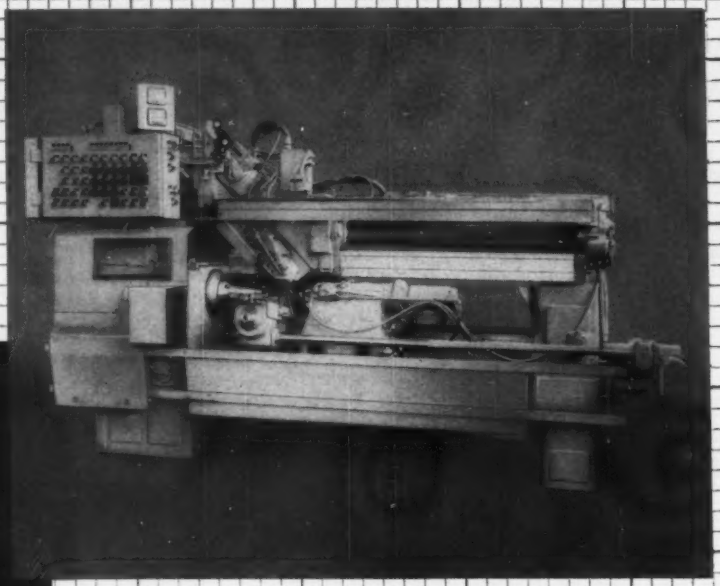


9 Units with 17 Spindles 12° Downhill

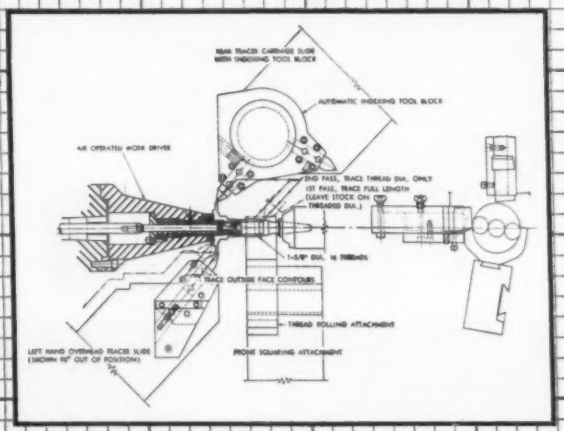
BUTT MILL
DRILL IN STEPS
.344 REAM
4 HOLES

THREE OPERATIONS ONE HANDLING

MODEL LQ AUTOMATIC TRACER LATHE TURNS BOTH ENDS AND ROLLS THREADS ON FRONT WHEEL SPINDLES IN ONE CHUCKING



Below: Close-up View of Tooling


REAR TRACER CARRIAGE SLIDE WITH THICKENING TOOL BLOCK
AUTOMATIC INDEXING TOOL BLOCK
HAND OPERATED WORK DRIVER
2ND PASS, TRACE THREAD DIA. ONLY
1ST PASS, TRACE FULL LENGTH (LEAVE STOCK ON THREADED DIA.)
1-5/8" DIA. 16 THREADS
TRACE OUTSIDE FACE CONTOURS
THREAD ROLLING ATTACHMENT
LEFT HAND OVERHEAD TRACER SLIDE (SHOWN 90° OUT OF POSITION)
FRONT SQUARING ATTACHMENT

Equipped with an auxiliary front slide and thread rolling attachment, this Seneca Falls Model "LQ" Automatic Tracer Lathe completes two turning operations and forms threads. The method of holding and driving the work piece on centers, as well as the two tracer carriages and the front squaring attachment which supports the thread rolling attachment, is shown in the tooling layout.

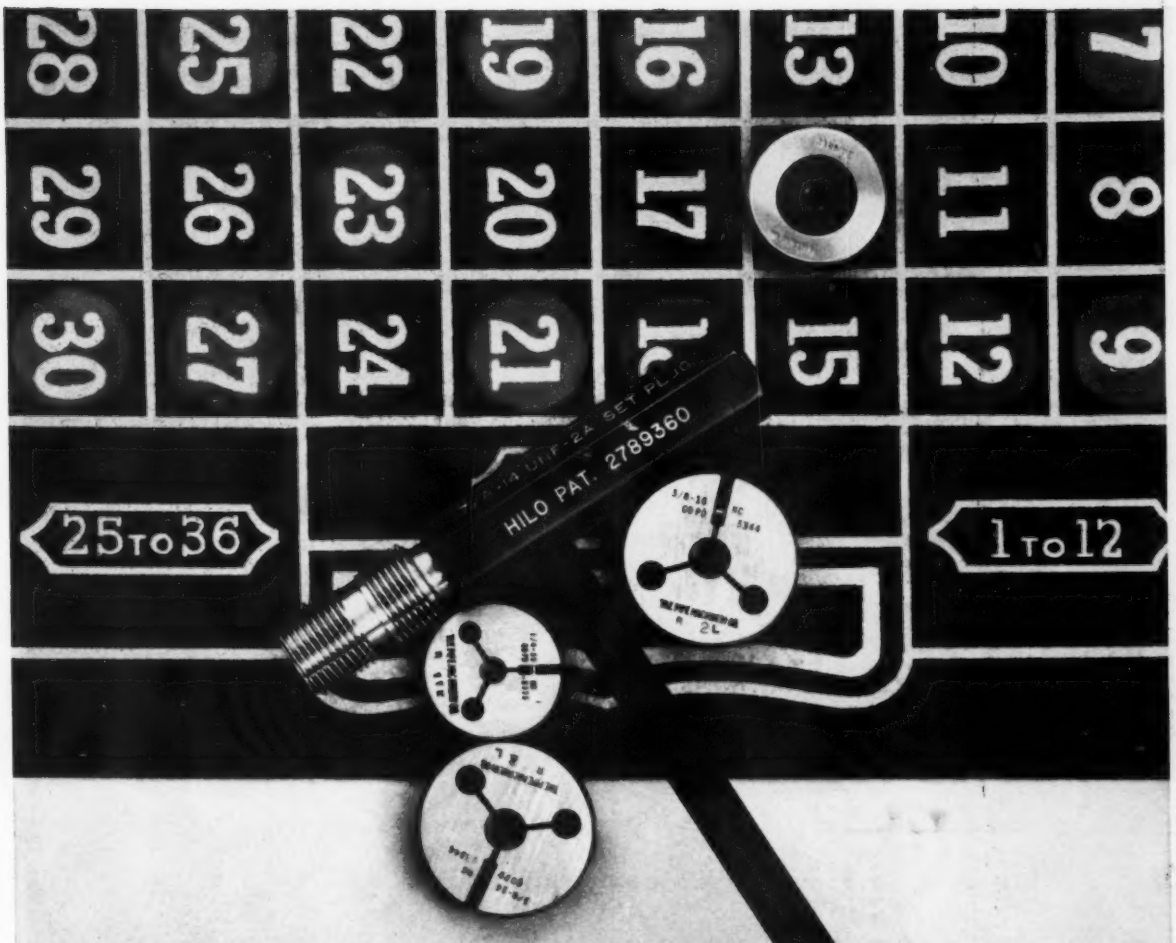
In operation, the left hand overhead tracer slide and the rear tracer slide operate simultaneously; the overhead carriage feeding towards the tailstock and the rear carriage feeding towards the headstock. The rear tracer slide is fitted with an indexing tool block which presents a separate tool for a qualifying cut over the threaded end on a short length second pass. Immediately following the second pass, the thread rolls advance to the center line of the work and then retract in rapid traverse.

The feed drive for the thread rolling operation is through a variable speed unit which controls the rate of feed as well as rapid traverse movements. The cycle is initiated automatically upon completion of the second pass over the threaded diameter. The front squaring cross slide attachment is operated by a barrel type cam revolving through 360°. The attachment may be adjusted along the bed in any location required to suit the thread on the work piece.

Investigate the versatility and many cost-cutting advantages of the Model LQ Tracer Lathe equipped with Seneca Falls Simplified Numerical Control.

Write for Bulletin Q-59

SENECA FALLS MACHINE CO., SENECA FALLS, N. Y.



Take the Gamble Out of Ring Inspection with Pipe Machinery Hilo Set Plugs

If you're relying on such questionable human yardsticks as "feel and shake" to determine whether or not your thread ring gages (solid or adjustable) are bell mouthed and out of limits, you're gambling recklessly with ring life—and possibly squandering it.

Pipe Machinery's new Hilo Plug provides a quick positive method for checking or setting thread ring gages... eliminates entirely any risk or uncertainty.

For More Complete Information on Pipe Machinery Hilo Set Plugs, write us on your company letterhead today.

THE PIPE MACHINERY COMPANY
29100 Lakeland Boulevard
Wickliffe, Ohio • Greater Cleveland

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Why Kearney & Trecker chose 8-channel punched paper tape input

The Kearney & Trecker Milwaukee-Matic is a remarkable tool even without numerical control. With NC, it's close to revolutionary. This automatic multi-machining center permits fast, economical small-lot manufacturing with minimum planning, far less lead time and dramatic reductions in tooling and inventory costs.

One major key to Milwaukee-Matic efficiency is the input. Kearney & Trecker picked 8-channel punched tape for reliability, durability, accuracy. And one thing more: ease of preparation on the Friden Flexowriter®. The Flexowriter has a standard typewriter keyboard. The operator (any competent typist) prepares a *visual* proof as she makes the tape. The machine parity-checks each code automatically. And finished tapes can be double-checked (or quickly duplicated) by running them back through the Flexowriter's reader.

Along with Kearney & Trecker, the great majority of machine tool manufacturers have already standardized on 8-channel punched tape input. Take it from them: punched tape is the best NC input. And in punched tape, Friden is the leader.

THIS IS PRACTIMATION: Friden is the world leader in tape technology and the practical application of the automation it makes possible. For full information, call your local Friden Systems Representative. Or write: Friden, Inc., San Leandro, California. ©1961 FRIDEN, INC.

Friden

Sales, Service and Instruction Throughout the U.S. and World

with this NEW *Cadillac* *Bore Set* PLA-CHEK®

You can set:

DIAL BORE GAGES
INSIDE MICROMETERS
TELESCOPING GAGES
INTERNAL CYLINDER GAGES

. . . much faster than you can read this page!

It's true! Time-saving is one of the big features of this new Cadillac Bore Set PLA-CHEK. Guaranteed accuracy is another! Designed especially to save time, money and to provide extreme accuracy in the setting and checking of Dial Bore Gages, Inside Micrometers, Telescoping Gages and Internal Cylinder Gages, this new PLA-CHEK is guaranteed to .000050". No gage blocks need be used and, in most cases, ring gage setting masters are not necessary. This new PLA-CHEK is the result of over 16 years' experience in the building of high-precision PLA-CHEK Gages. It is designed for easy portability on the job so that it may be used either on the surface plate or at the machine. Write, wire or telephone TODAY for prices and additional information.

Use it as a regular PLA-CHEK, too!

You get a two-for-one value with the new Cadillac Bore Set PLA-CHEK. It is also a regular 13" self-contained PLA-CHEK Gage for use on all checking and inspection jobs where extreme accuracy is important and where speed is essential. The Bore Gage Set Block assembly may be removed or it may be used as a reverse checking plate. Other PLA-CHEKS include the 6", 12", 18", 24", 36" and 48" models.

Cadillac GAGE COMPANY

P. O. BOX 3806 • DETROIT 5, MICHIGAN

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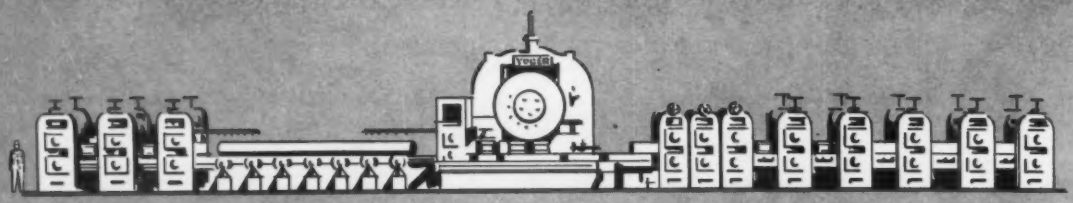
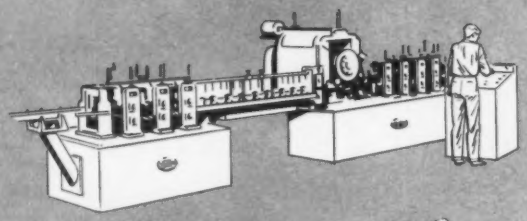
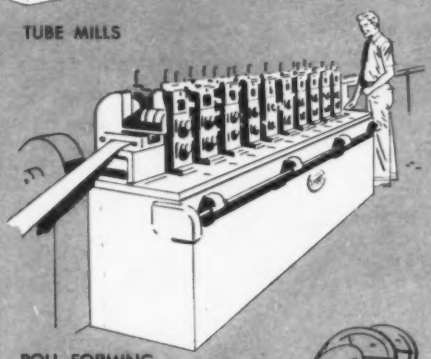


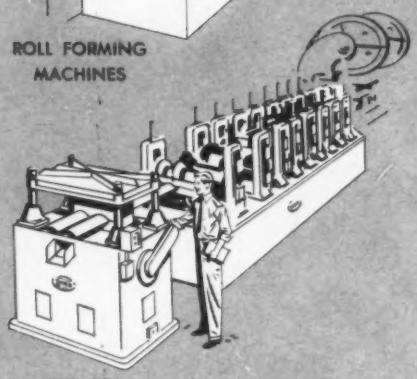
PIPE MILLS



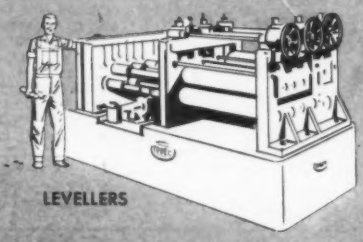
TUBE MILLS



ROLL FORMING MACHINES



CUT-OFFS



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YODER MAKES THEM ALL

...Complete equipment lines for heavy or light production!

Uncoilers, slitters, roll-forming machines, cut-offs, pipe and tube mills, special machinery for ferrous or non-ferrous metals are all made and engineered by Yoder to fit your specific requirements.

Special attachments and auxiliary units can perform additional operations such as welding, coiling, punching or embossing without extra labor cost while increasing production speed.

Let Yoder engineering and "know-how" help you get the most from your plant ... with Yoder equipment. For full details, write to:

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5504 Walworth Ave. • Cleveland 2, Ohio

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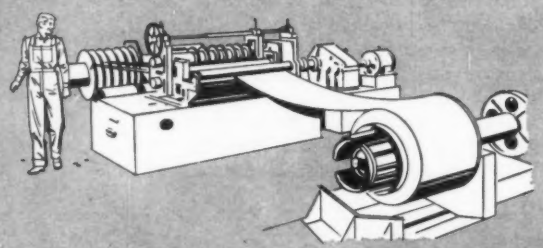
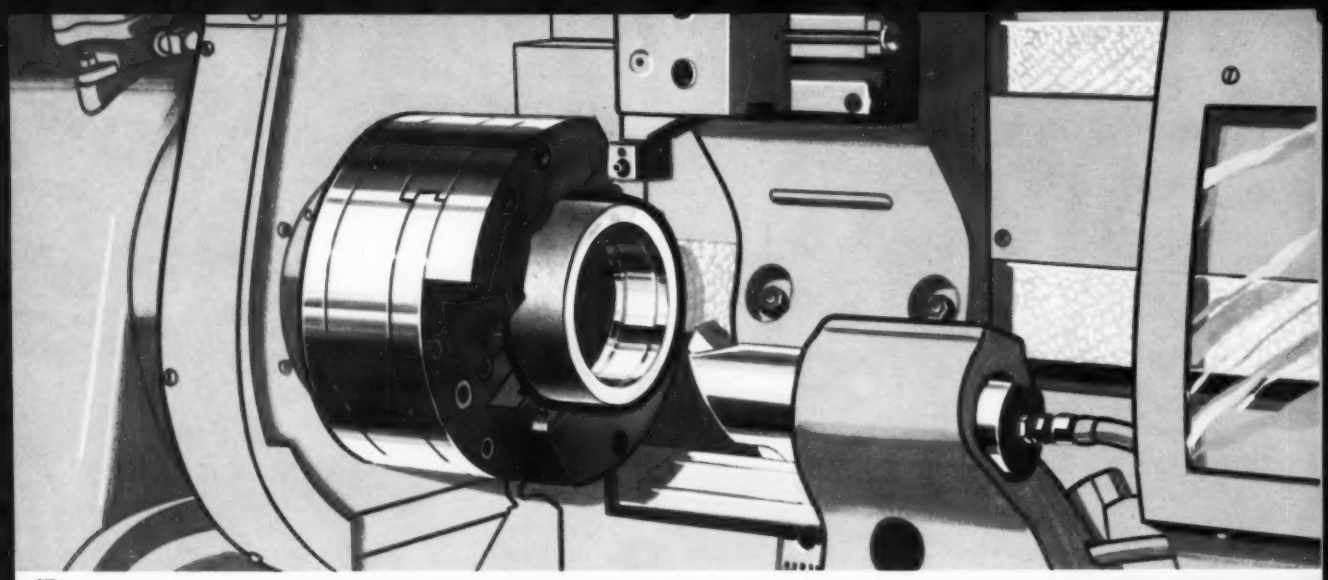
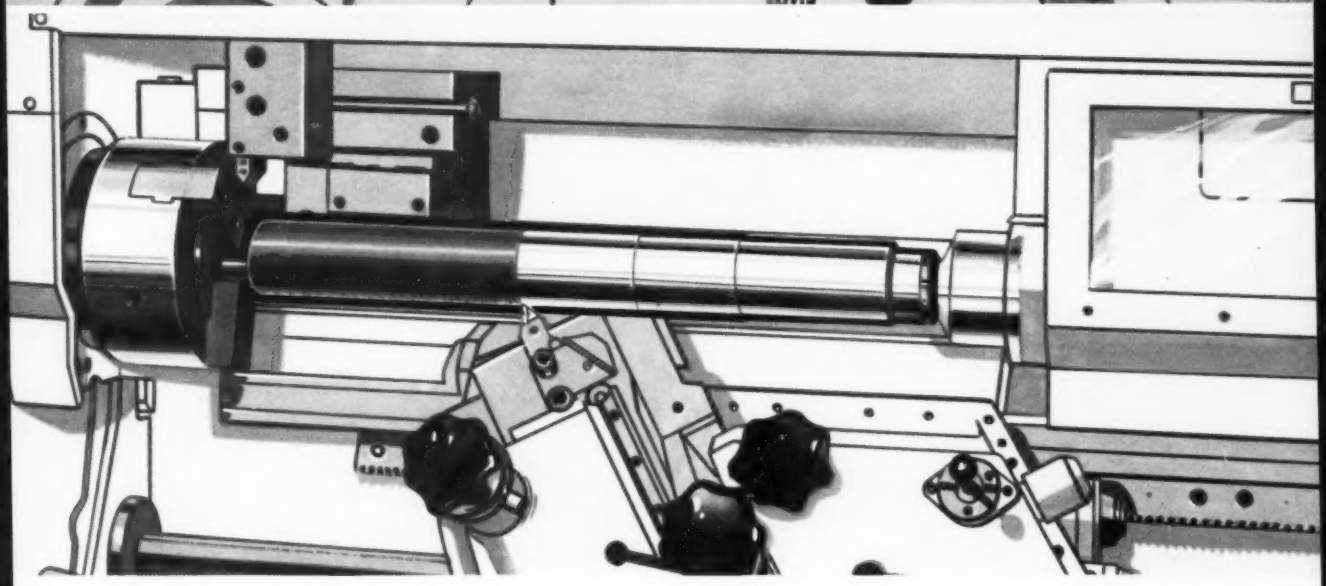


RECOILERS SLITTERS UNCOILERS

ENGINEERING **YODER** MANUFACTURING

PIPE AND TUBE MILLS (ferrous or non-ferrous)
COLD ROLL FORMING MACHINES
ROTARY SLITTING LINES





Years-ahead flexibility
in New Britain's +GF+ *Copying Lathes*

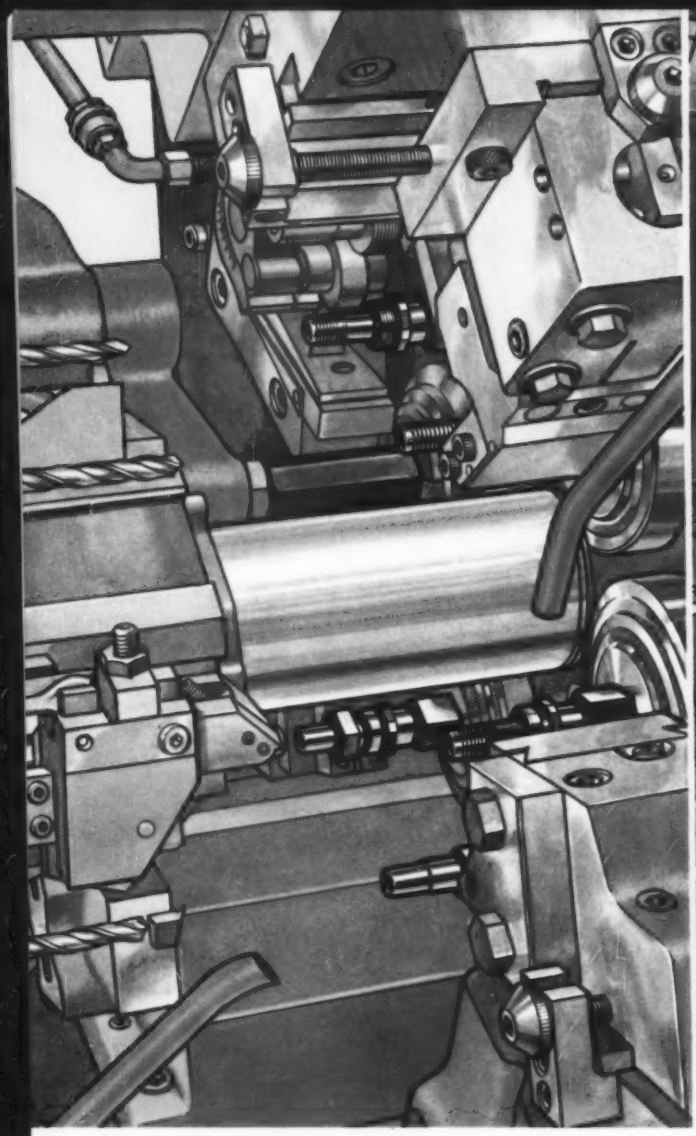
One of the best ways of making sure you're on the right track when you buy a new machine is knowing what you want the equipment to do and then being sure the equipment you buy can do it. This sounds pretty basic, but it's difficult to forecast just what you are going to require of a machine through all the years you will use it. In this department, the New Britain +GF+ Copying Lathe has a lot of peace-of-mind insurance built right into it. For instance, the basic design of the machine suits it for a wide variety of work. The single-tool copy-turning principle is equally well suited for both chucked *and* between-centers work on internal and external surfaces.

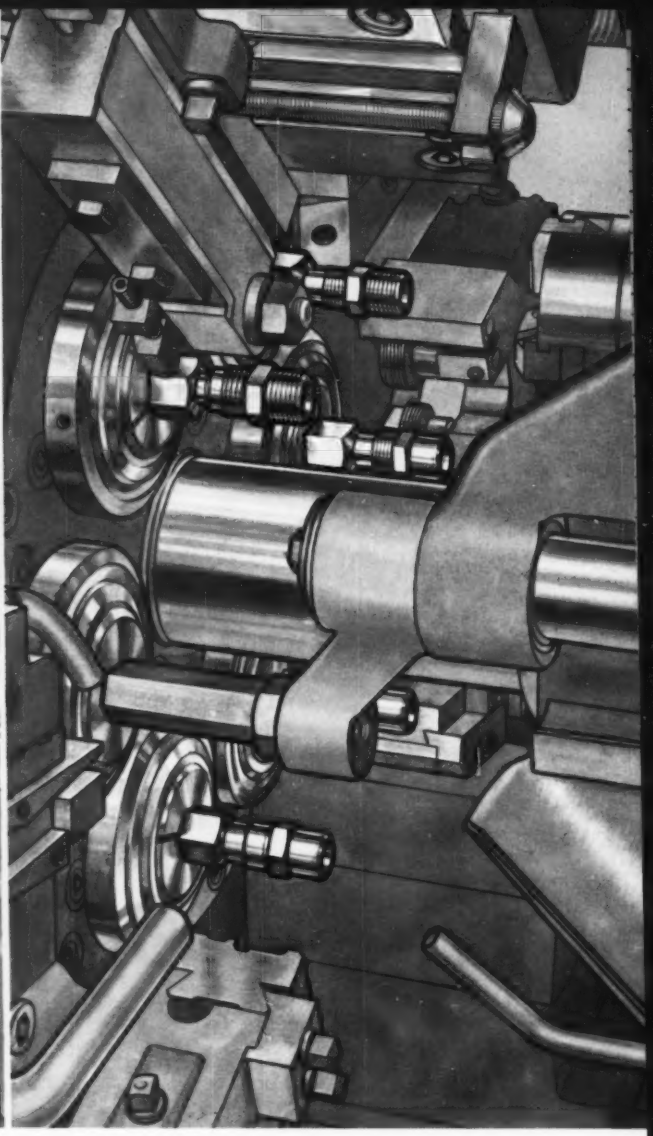
Because the tool path is controlled by an easy-to-install template (or a prototype) set-up and change-over are accomplished in a few minutes. The cutting tool can be replaced in a matter of seconds. Back facing is accomplished as part of the machining cycle by means of a top-mounted attachment.

The New Britain +GF+ is truly a machine that can pull more than its own weight in any metal-working shop. On top of that, it can adapt quickly and easily to the widest possible number of new requirements that may be placed on it in the years to come. A new catalog describes the complete line in detail.

THE NEW BRITAIN MACHINE COMPANY

New Britain-Gridley Machine Division ◆ New Britain, Connecticut





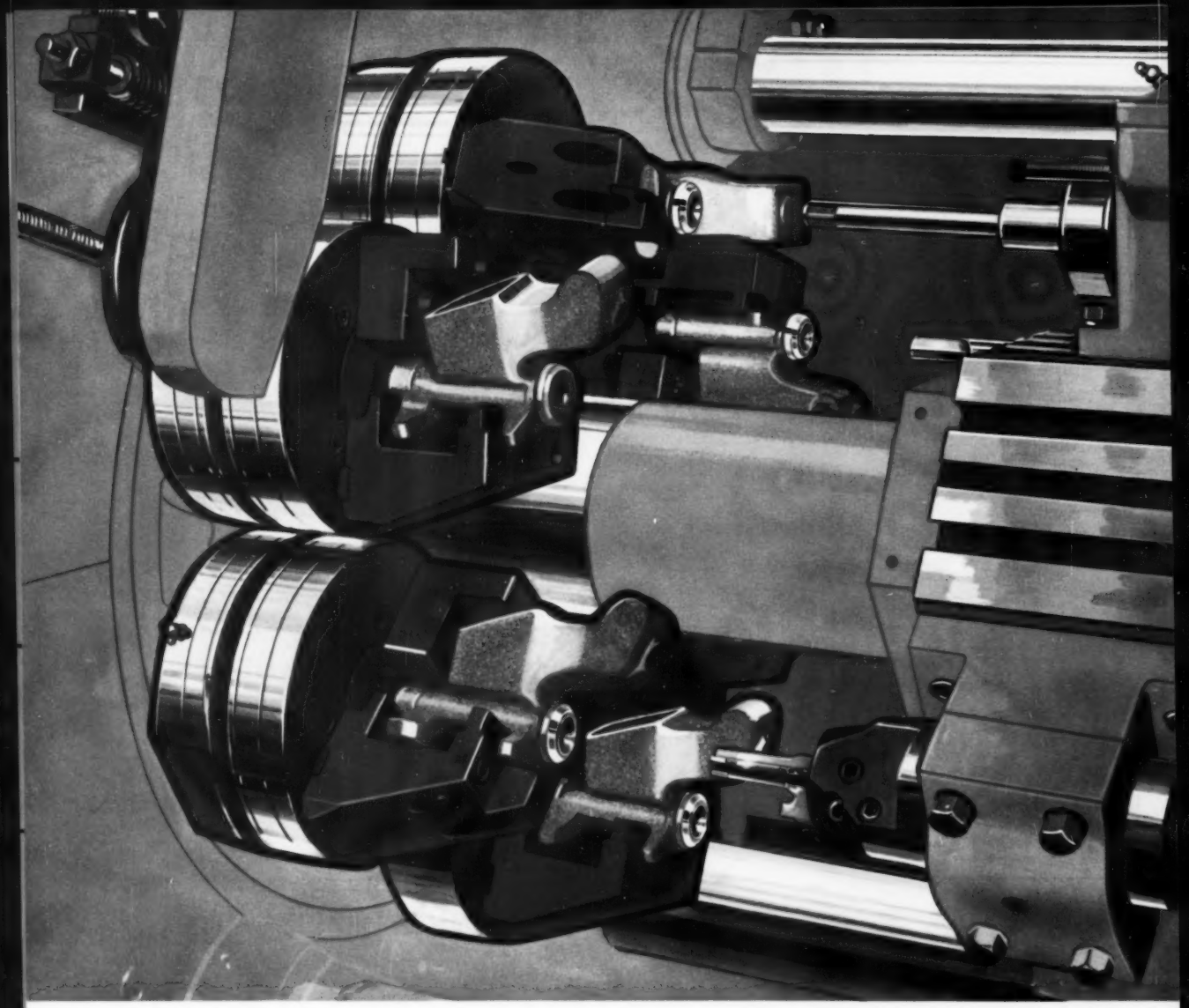
Stainless, 225 per hour— brass, 1500 per hour

Speed is only part of the story on New Britain's completely new line of four-, six-, and eight-spindle bar machines. Guaranteed accuracy, production run after production run, year in, year out, helps round out the story. If you haven't seen any of the new series in action—six models in all—you owe it to yourself and the profitable productivity of your plant to arrange for a demonstration. All of the exclusive New Britain features you are probably familiar with have been retained and improved. New features unavailable on any other machines have been added. The result—the finest high speed bar turning units on the market. Your New Britain representative is the man to see. He can show you applications, parts production case histories, show you to fractions of seconds and pennies why new New Britain bar machines are an investment in greater profits with every piece they produce.

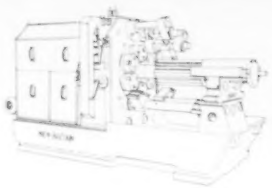
Model	Spindles	Cross Slides	Spindle Speeds	Spindle Capacity	H.P.
450	4	4	41-621	5⅛"	30-50
52	6	6	271-4250	1¼"	15-25
62	6	6	177-2519	1⅝"	15-30
62	6	6	177-2519	2¼"	20-30
635	6	6	63-630	3½"	30-50
826	8	6	98-1481	2⅝"	30-50

THE NEW BRITAIN MACHINE COMPANY

New Britain-Gridley Machine Division • New Britain, Connecticut



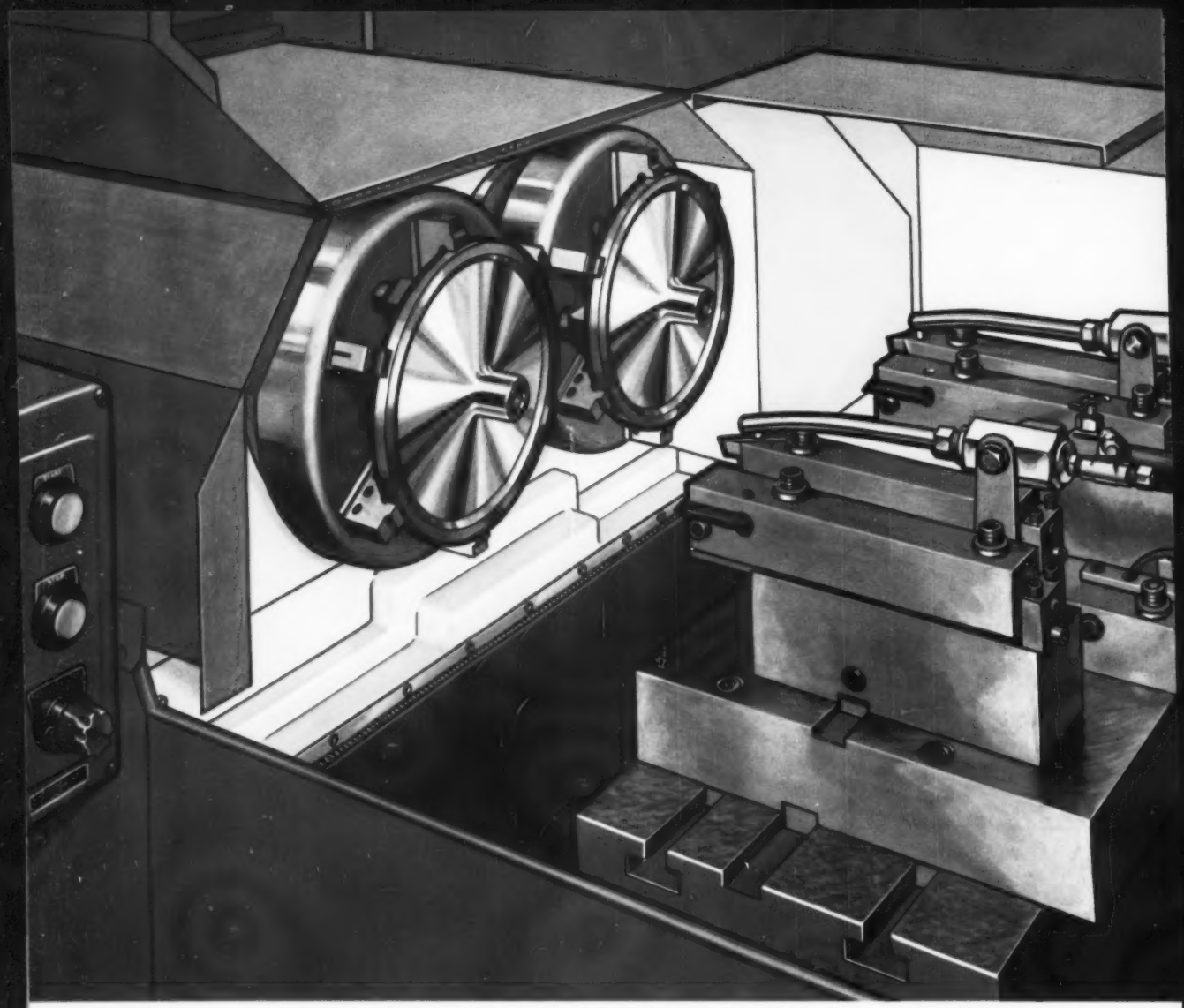
Odd shapes no problem
on New Britain Chuckers



The peculiar problems presented by odd shaped pieces are frequently as varied as the pieces themselves. The cut may be simple enough but the how and wherefore of chucking and swinging the piece may be something else again. New Britain Chuckers can handle the widest possible range of pieces—even odd shaped work. Open-end design which allows wide open accessibility to the tooling area makes the work easier to chuck, and easier to watch during the machining cycle. Because the work area is more open, this kind of work is easier to swing on a New Britain. This is one of many extras that are built into New Britain Chuckers. Another basic New Britain difference that pays off handsomely is the exclusive forming arm design which allows for the greatest possible variety of side cuts without special set-up. The combinations of end-working and forming cuts possible are practically unlimited. This flexibility of tooling coupled with big capacity lets New Britain users perform the widest possible variety of chucking machine work. Why not call in your New Britain representative?

THE NEW BRITAIN MACHINE COMPANY

New Britain-Gridley Machine Division ◆ New Britain, Connecticut



New Britain cam actuated *boring and contour turning*

Extreme accuracy, high productivity—even on complex contoured surfaces—these are the areas where New Britain's Vertical and Horizontal Precision Contour Turning and Boring Machines take the kinks out of production. Tool slides are cam actuated, generating contoured and straight surfaces, including sharp corners and exact radii. Time consuming wheel forming and dressing required by some methods of producing close tolerance, fine finish work are eliminated.

This is basic with New Britain and is a good part of the reason for the unbeatable repetitive accuracy of these machines. Both verticals and horizontals are simple to operate and simple in operating principle. Normally, gaging one dimension is sufficient. From one to four high speed spindles can be mounted on a single machine.

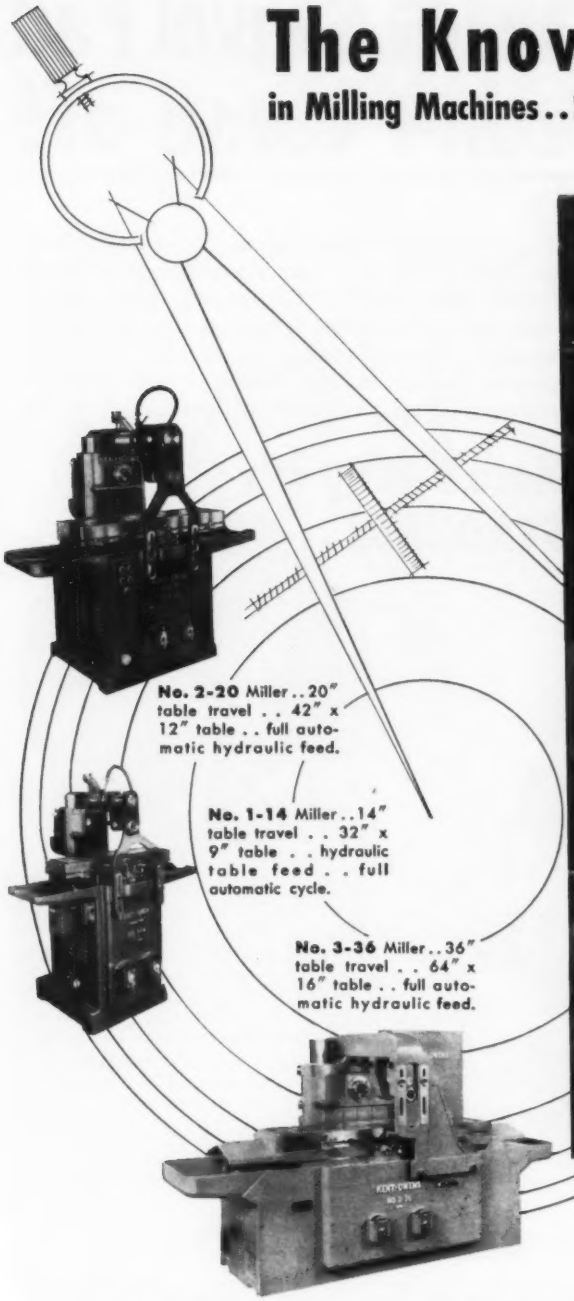
The widely accepted horizontals, or the completely new and revolutionary verticals with exclusive cam-in-head design, can be seen in action simply by contacting your New Britain representative. Whether you require one machine, several machines, the best approach to a building-block set-up, or whatever your precision contour turning or boring requirement may be, check with New Britain before you decide.

THE NEW BRITAIN MACHINE COMPANY

New Britain-Gridley Machine Division ◆ New Britain, Connecticut

The Know-How Dimension

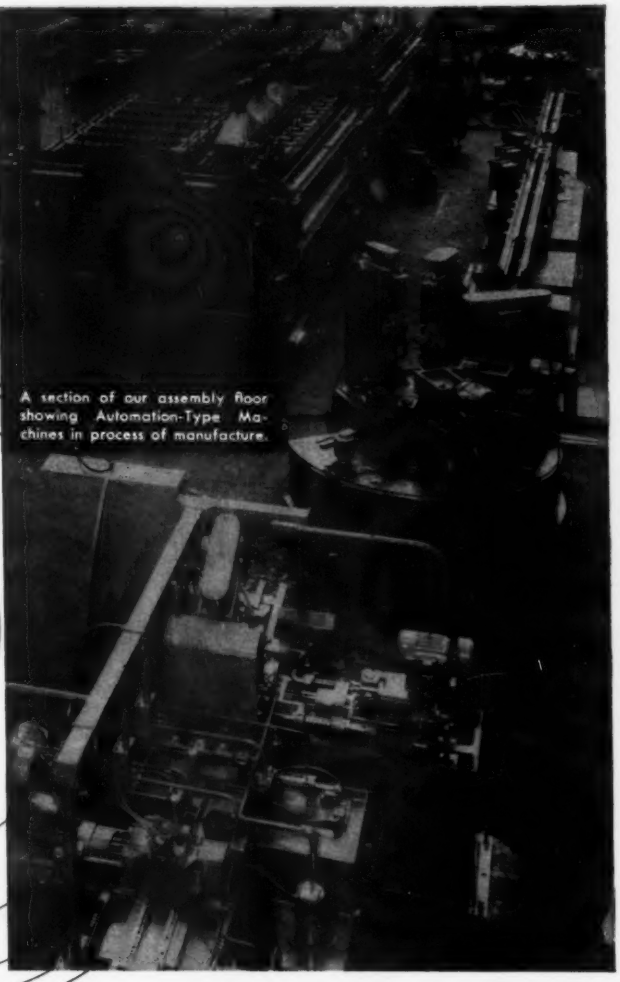
in Milling Machines . . Special Machinery . . Automation Equipment



No. 2-20 Miller . . 20" table travel . . 42" x 12" table . . full automatic hydraulic feed.

No. 1-14 Miller . . 14" table travel . . 32" x 9" table . . hydraulic table feed . . full automatic cycle.

No. 3-36 Miller . . 36" table travel . . 64" x 16" table . . full automatic hydraulic feed.



A section of our assembly floor showing Automation-Type Machines in process of manufacture.

. . makes the difference in cutting costs . . increasing production

Know-How, born of years of experience, abetted by sound and imaginative design and quality manufacturing standards . . . is the reason why many of our customers, representing a wide and diversified coverage of industry, come back to us again and again for *answers* to their production problems.

When you are considering procurement of machinery for your milling needs . . . or seeking the solution to other production problems . . . you may wish to consider a Kent-Owens Milling Machine or a Special Machine designed for a distinctive and individual application. Contract Machine Building (customer designed equipment) is another of our specialties.

Write or call . . . Kent-Owens will be pleased to quote your requirements. Kent-Owens Machine Company, Toledo 10, Ohio.

KENT-OWENS *Designers and Builders of Milling Machines and Special Machinery*

New ARMSTRONG Swivel Pad can't come off

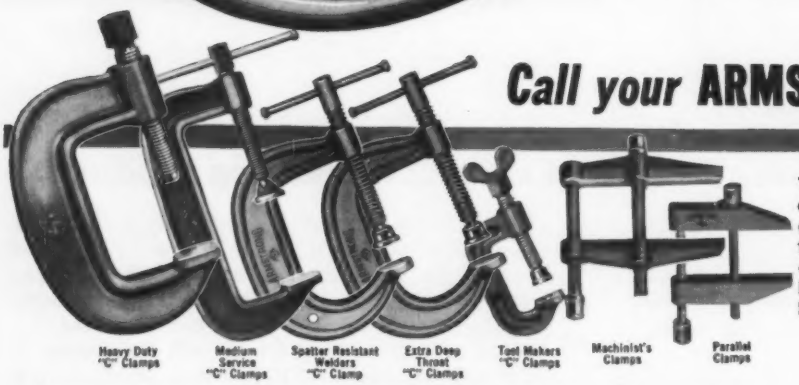
Now ARMSTRONG deep throat "C" Clamps have the new (Pat. apd. for) ARMSTRONG Ball-joint Swivel Pad. This "C" Clamp pad, developed by ARMSTRONG Engineers, is tougher than any on the market. Rigorous testing in our own plant first proved this fact, and field tests in factories throughout the country have confirmed our own test results.

Here's Why it's STRONGER . . .

The lip of the opening in the ARMSTRONG Ball-joint Swivel Pad is undercut so that when the ball of the screw is inserted, and the lip is permanently forced down, a solid steel wall is formed, inside the pad cavity, completely encircling the ball.

This wall of steel makes it impossible for the pad to come off the screw during normal use. In fact, our tests have proved that it is virtually impossible to intentionally knock the pad off with a hammer —yet the pad is free to swivel through an arc of approximately 40°.

Call your ARMSTRONG Distributor



Your ARMSTRONG Distributor can offer delivery from stock on this "400-Series" deep throat, drop-forged "C" Clamp with the new Ball-joint Swivel Pad. He also carries in stock the other styles of clamps in the ARMSTRONG Line—the broadest line of drop forged "C" Clamps.

ARMSTRONG BROS. TOOL CO., 5213 W. ARMSTRONG AVE. CHICAGO 46, ILLINOIS

SEE US AT BOOTH #3906, ASTME SHOW, NEW YORK COLISEUM

INVOLUTE PROFILES

Now checked to LABORATORY PRECISION

The New Red Ring Involute Checker was developed primarily to inspect gear shaving cutters for which maximum precision is imperative. It utilizes the base circle technique but with major design modifications and added refinements to increase accuracy, improve dependability and facilitate handling.

PRINCIPAL FEATURES

- **Two dial indicators (.0002″ graduations) are provided, one for each side of the tooth being checked.**
- **With opposed indicators, instrument set-up is quickly verified by checking the work with one, reversing it and making a comparative check at the same point with the other.**
- **A protractor on the contact finger holder assures proper helix setting. This is pivoted to swing through 180° in order to check both sides of the tooth without angular adjustment.**
- **Work is mounted on ball bushings to minimize the effect of eccentricity.**
- **A self-disengaging spindle lock secures spindle while base circle disc is being mounted.**
- **Indicating slide is mounted on rollers to avoid brinelling or grooving the ways.**
- **Indicating slide is driven by a self-locking gear mechanism to prevent the slide from running free.**
- **Work slide is carried on box ways for better control.**

RECORDING

Rectilinear recording on 6 inch tape is provided. Thus, both sides of three teeth can be accommodated on one section of tape. Amplification of 10:1 spreads .050″ of finger travel over .50″ of graph.

SPUR AND HELICAL GEAR SPECIALISTS
ORIGINATORS OF ROTARY SHAVING,
GEAR HONING AND ELLIPTOID

NATIONAL BROACH & MACHINE CO.

5600 ST. JEAN . . DETROIT 13, MICHIGAN

WORLD'S LARGEST PRODUCER OF GEAR SHAVING AND HONING EQUIPMENT

For more data circle this page number on card at back of book

HERE IS THE GRINDER YOU ASKED FOR!

● A smaller (14" x 42" or 14" x 48" table) heavy duty, high precision surface grinder with controls at eye level retaining all the features that have made HILL horizontal spindle hydraulic surface grinders famous for precision production during the past twenty years. This is an entirely NEW grinder brought out at your request to compliment the line of HILL heavy duty surface grinders of larger sizes. Where initial cost and limited floor space are critical factors we believe that this new, smaller HILL grinder will solve your finer finishing problems. Full details are given in bulletin 58GS.

HILL Horizontal Spindle grinder with fully hydraulic table and cross feeds. Size: 14" x 42" table with 16" clearance. Magnetic chuck is standard equipment.

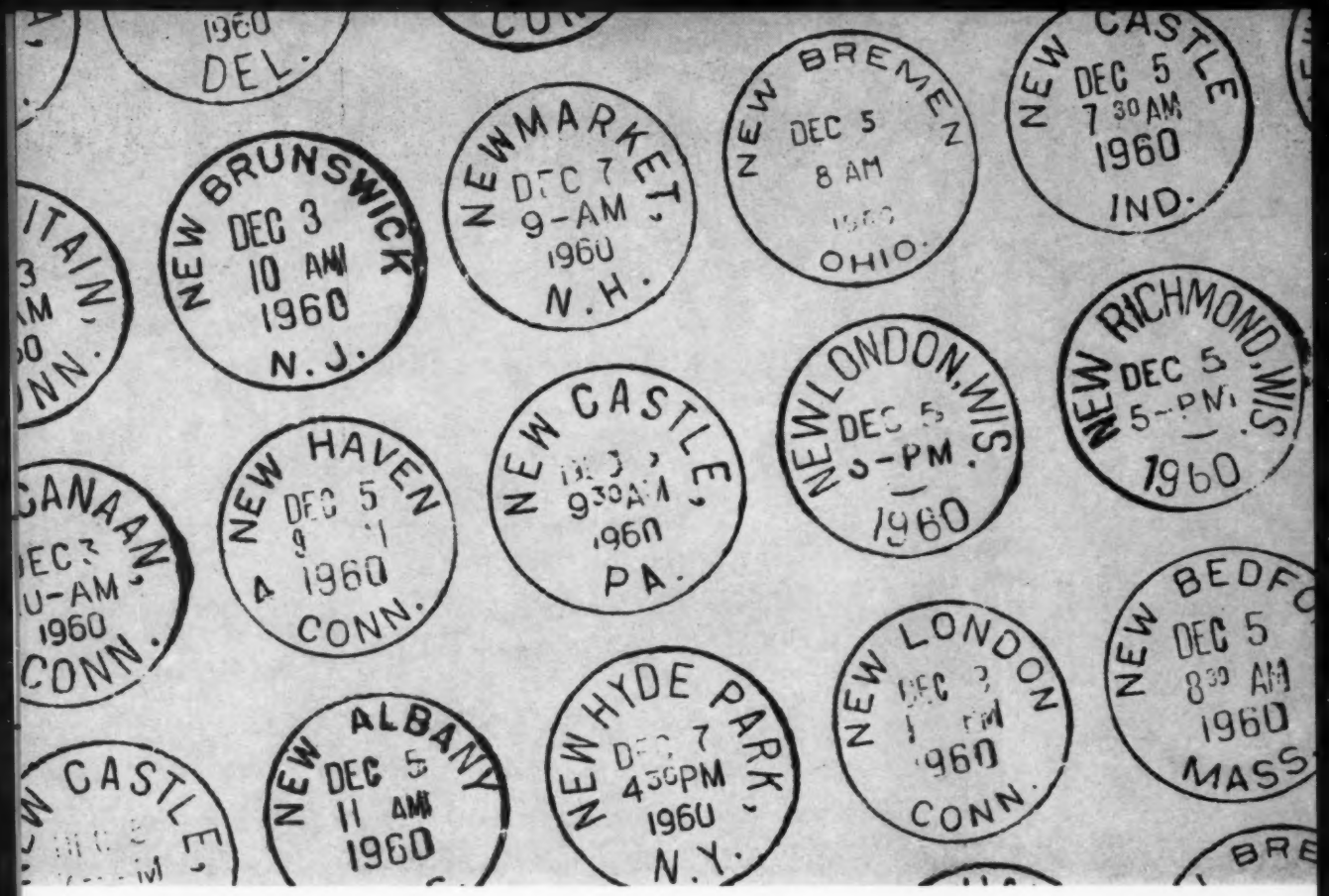
Of course we still make the full line of HILL horizontal spindle and vertical spindle grinders in the larger sizes with table lengths from 5 to 20 feet.

THE HILL ACME COMPANY

1207 W. 65th STREET
CLEVELAND 2, OHIO

HILL-ACME TOOLS FOR INDUSTRY

Manufacturers of: "HILL" Grinding & Polishing Machines — Hydraulic Surface Grinders — "ACME" Forging — Threading — Tapping Machines — "CANTON" Alligator Shears — Billet Shears — "CLEVELAND" Knives — Shear Blades



Wherever your tooling operation is located... here's a low-cost answer to common headaches

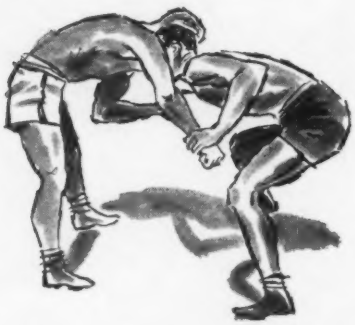
From New Haven to New Castle and points West . . . wherever toolmen want a simplified, low-cost answer to many tooling problems . . . Carpenter STENTOR (Oil-Hard) enjoys tremendous popularity. Here's why: STENTOR is one die steel you can live with. Its sound, uncomplicated analysis . . . free from hard-to-machine alloys . . . saves as much as 10% in machining costs. STENTOR is easy to heat treat . . . hardens at a low temperature of 1425°F to 1525°F. You'll like its freedom from decarb because STENTOR holds size so accurately many people do not even grind STENTOR tools after hardening. Little wonder it is the most widely used of all die steels in the Carpenter Matched Set of twelve! Put through an order now—you can get prompt delivery from your nearest Carpenter Service-Center.

Carpenter steel

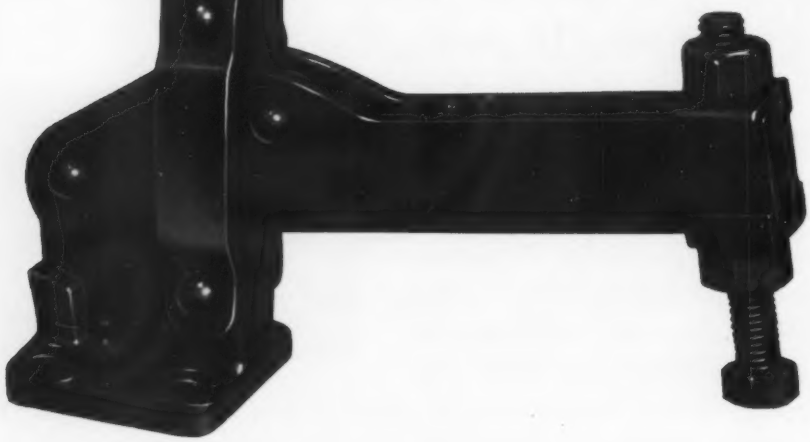
You can do it ***consistently*** better with Carpenter Tool and Die Steels

The Carpenter Steel Company, Main Office and Mills, Reading, Pa.
Alloy Tube Division, Union, N. J.
Webb Wire Division, New Brunswick, N. J.
Carpenter Steel of New England, Inc., Bridgeport, Conn.

UNIVERSAL
TOGGLE-ACTION
UNI-KLAMP
quick, positive, sturdy



Universal's Toggle-Action Uni-Klamps are engineered to give positive action with a minimum of force required for locking or unlocking. They're the fastest and most economical work-holding devices yet designed and they incorporate features recommended by independent tool designers, process engineers, tool makers and machinists. With clamp pressures available from 200 to 1200 lbs., there's a Universal Uni-Klamp in a size and type to suit your requirements. Write for catalog showing complete line.



TOGGLE LATCH TYPE CLAMPS | PUSH-PULL CLAMPS | PORTABLE CLAMPS | AIR OPERATED CLAMPS

UNIVERSAL ENGINEERING COMPANY • FRANKENMUTH 2, MICH. 218

4-col. presses bristle with production boosting features

KRW has done it again! This time, the 25-1000 ton KRW line of 4-column, single action hydraulic presses has been modernized to set a new pace over a broad work range.

Bristling with newness, these smooth-acting machines are built to outperform even KRW's highly regarded, prior designs in a wide variety of assignments: Blanking, forming, punching, trimming, drawing, extruding, briquetting, straightening, pressure clamping, laminating and bonding.

Already acclaimed "a marked success," KRW's latest version of the 4-column press boasts numerous features to improve quality and increase productivity: Of rugged, welded steel construction, the crown, bed and sliding platen provide maximum resistance to deflection. Align-bored to automatically controlled tolerances, the sliding platen is guided on ground and polished columns which are closely fitted into the crown and bed.

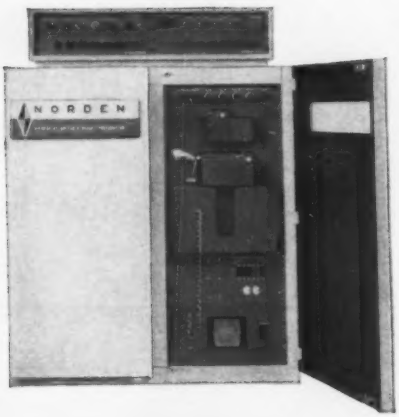
Easy to adjust, KRW hydraulic systems assure instant, complete press control. Compactly designed, the pumping unit can be mounted at the top of the press or furnished for floor installation.

Available with either up-acting or down-acting platens, KRW 4-Column Presses can be outfitted with manual lever or electric push buttons for single or continuous cycling.

For detailed information and specifications, write for Bulletin 95-D. K. R. Wilson, Inc., 214 Main St., Arcade, N. Y.

KRW HYDRAULIC PRESSES

NORDEN Modumatic control systems for automatic positioning



The Norden Series 600 is a numerical control system for automatic point-to-point linear or rotary positioning.

This system features a new concept in numerical control with modumatic design permitting the exact degree of automation required.

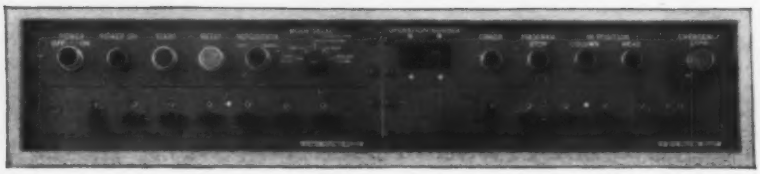
This new concept is achieved by an exclusive design utilizing an absolute digital feedback transducer, electronic circuitry, and visual display. It offers complete automatic positioning with input from either manual dial-in or punched tape. Display units provide continuous decimal readout of *actual* position—not command.

NORDEN 600 SERIES FEATURES:

Full Range Electronic Origin Select—allows desired offset to be quickly and easily dialed in by the operator on manual selector switches.

Actual Position Readout—the actual position is displayed in straight decimal form by illuminated numbers that are readable from twenty feet.

Full Range Electronic Positioning Select—allows positioning to be controlled manually or by tape. Tape program can be interrupted to insert additional or intermediate operations.



Controlled Programming—with automatic tape punch equipment, tapes may be prepared "on the machine" providing a permanent inspection record or a programmed tape for playback applications.

For complete details on the Series 600, or other modumatic control systems, contact your nearest Norden Representative—400 Main Street, East Hartford, Connecticut, JAckson 8-8411—11 West Ave., Dayton 2, Ohio, BAldwin 8-4481, or write to us at the address below.

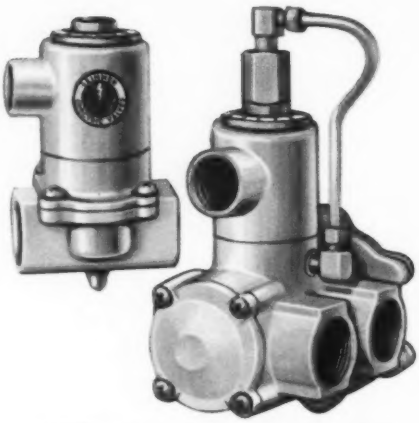
NORDEN DIVISION OF UNITED AIRCRAFT CORPORATION
DATA SYSTEMS DEPARTMENT
3501 HARBOR BOULEVARD, COSTA MESA, CALIFORNIA

SKINNER EXPLOSION-PROOF SOLENOID VALVES

Skinner has a complete range of Explosion-Proof Solenoid Valves

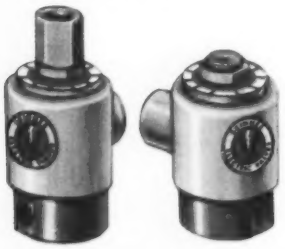
If you have a control problem involving valves operating in hazardous locations—Class I Group D (gasoline vapors, etc.), Class II Group F (coal and coke dust) and Group G (grain dust)—you can select from Skinner's complete line of two- and three-way explosion-proof standard and high pressure solenoid valves.

- **U.L. approved**
- **A wide range of pressure ratings and orifice sizes**
- **Bodies and coil housings machined to close tolerances—clearance is 0.0005**
- **Stainless steel or naval brass bodies**
- **Stainless steel internal parts**
- **Stainless steel and brass internal parts**



STAINLESS STEEL TWO- AND THREE-WAY SOLENOID VALVES—X5 SERIES

The highest quality and most versatile valves manufactured. So flexible that basic valve can be modified to provide porting, mounting, or flow-control, to meet most applications.



Two-way solenoid valves are available normally closed, normally open and dual purpose. Orifice sizes from 1/32" to 3/16", maximum operating pressure differential 3000 PSI depending on orifice size—NPT pipe size 1/8", 1/4" and 3/8".

Three-way available normally closed, normally open, directional control and multi-purpose. Orifice sizes from 3/64" to 1/4", maximum operating pressure differential 200 PSI depending on orifice size.

TWO-WAY PISTON TYPE SOLENOID VALVES—XR SERIES

These valves, with forged naval brass body and stainless steel piston, handle high flow and high pressure requirements of industrial and commercial applications with most common media.

XR series valves are available with 1/4" orifice and 1/4" NPTF in normally closed or normally open construction. Operating pressure differential 5 to 1250 PSI for AC operation and 5 to 1000 PSI for DC operation.

TWO- AND THREE-WAY HIGH FLOW SOLENOID VALVES—XL SERIES

These diaphragm type solenoid valves meet the high flow requirements of a great many commercial and industrial applications. The unique Skinner diaphragm construction makes possible the exceptionally long service life of this series valves.

Two-way XL series valves are available normally closed and normally open. Orifice sizes are 1/2", 3/4" and 1" with corresponding NPTF pipe connections. The 1/2" orifice model is also available with 3/8" NPTF. Operating pressure differential is 5 to 150 PSI.

Three-way XL series valves are available normally closed, normally open and directional control. Orifice sizes are 3/8", 1/2" and 3/4" with corresponding NPTF pipe connections. Operating pressure differential is 5 to 150 PSI for the 1/2" and 3/4" size and 10 to 150 PSI for the 3/8" size.

TWO- AND THREE-WAY HIGH PRESSURE HYDRAULIC SOLENOID VALVES—X10 SERIES

These stainless steel, direct acting, slide-type valves are precision engineered to control hydraulic systems at pressures up to 2000 PSI.

These high pressure hydraulic valves have a 3/32" inlet and cylinder orifices with 1/8" NPT. They can be used as two-way normally closed or two-way

normally open valves by plugging the appropriate port, and three-way normally closed, or three-way normally open, or dual purpose valves.

• • •

For complete information, contact a Skinner Distributor listed in the Yellow Pages or write us at the address below.

When you specify solenoid valves, specify Skinner. Skinner solenoid valves are distributed nationally.

SKINNER · ELECTRIC VALVES ®

THE CREST OF QUALITY

SKINNER ELECTRIC VALVES

SKINNER ELECTRIC VALVE DIVISION
SKINNER PRECISION INDUSTRIES, INC. • NEW BRITAIN, CONNECTICUT, U.S.A.

PRINTED IN U.S.A.

AGAIN-

Shown here is the 6" Rapidaytor Dolphin Submersible Pump, one of a complete line of 4" and 6" pumps made by THE TAIT MANUFACTURING COMPANY, Dayton, Ohio. Arrow points to the upper body shell made of Revere seamless leaded brass tubing. Hand holds the diffuser casing made of Revere Brass Strip and used inside pump.

Revere helps "fit the metal to the job"

AND A PUMP MANUFACTURER FABRICATES SUPERIOR PARTS WITH GREATER EASE . . . INCREASES TOOL LIFE

An important part of the submersible pumps made by Tait Manufacturing Company is the brass diffuser casing you see above. This part had formerly been made of ferrous metal. While satisfactory as a pump part it was difficult to work and draw . . . at the same time tool life was short.

One of Revere's Technical Advisors was asked to study the problem. Revere Cartridge Brass Strip of a certain temper was recommended, samples submitted, and, after extensive tests, was approved. The customer has found that not only does the diffuser casing, made of Revere Brass, perform well in the pump, but it also has superior drawing properties, is more easily worked, and tool life has been substantially increased.

This meticulous attention to "fitting the metal to the job" also resulted in Tait Manufacturing Company's specifying Revere seamless leaded brass tubing for the upper body shell of its submersible pumps. Here the application called for extremely close straightness and roundness control which meant special attention to detail on the part of the Revere mills.

Why not put the extensive knowledge of Revere's T.A. Service to work for you? With the wide variety of metals at your disposal, perhaps Revere can help you select the one best suited for the job, with a resultant saving of money while improving product quality.

REVERE COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

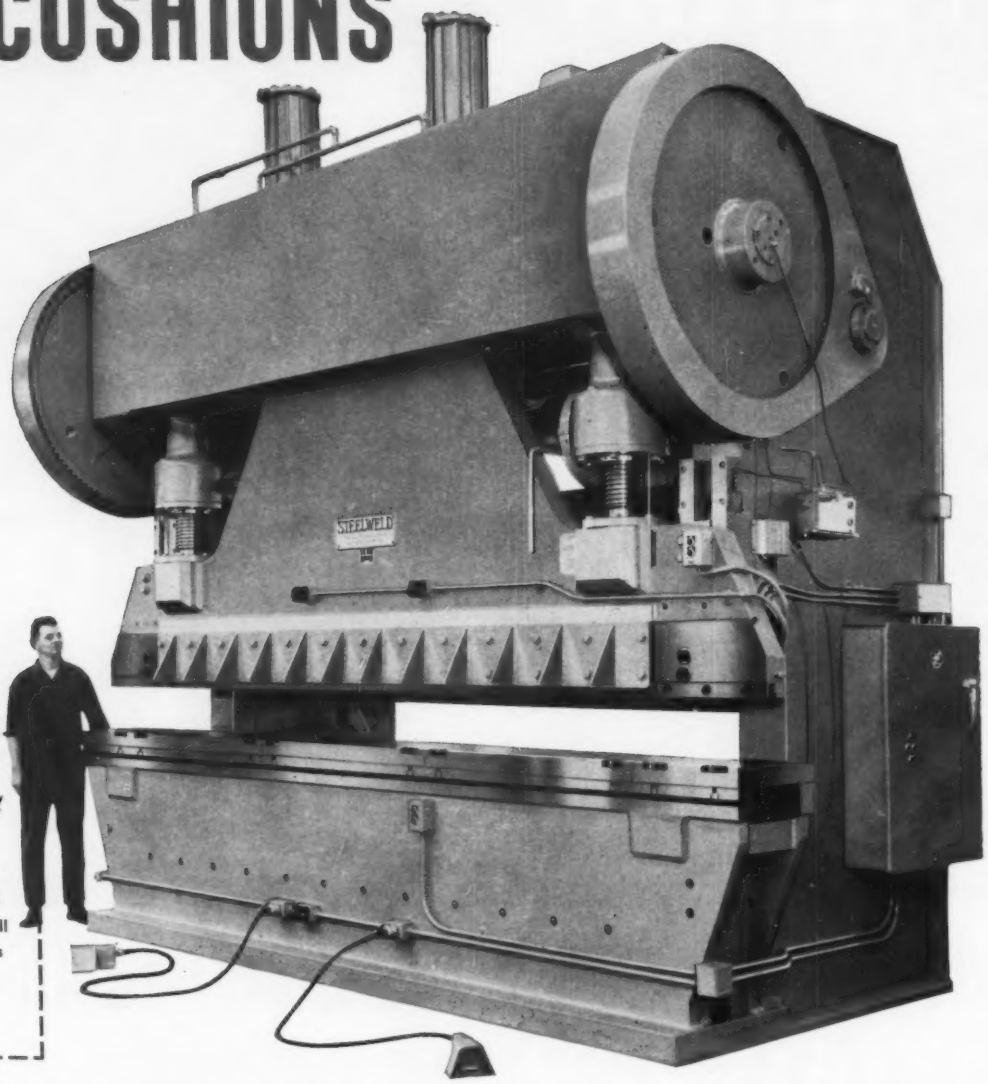
Executive Offices; 230 Park Avenue, New York 17, N. Y.

Sales Offices in Principal Cities. Mills: Rome, N. Y.; Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles, Riverside and Santa Ana, Calif.; New Bedford and Plymouth, Mass.; Brooklyn, N. Y.; Newport, Ark.; Ft. Calhoun, Neb.

Distributors Everywhere.

PRESS BRAKES with DIE CUSHIONS

This die-cushion-equipped mechanical Steelweld press brake has two speeds, 7 and 20 strokes per minute. Stroke length is 6 inches. Shut height is 20 inches.



Steelweld *Mechanical and Hydraulic* **Press Brakes** are available in all sizes to 2000 tons capacity for plate lengths to 30 feet.

Steelweld Press Brakes — mechanical or hydraulic — can be furnished with die cushions built in.

The brake illustrated was provided with twelve pneumatic die cushions assembled in a single line between the two bed plates. Each has a rating of four tons, or 48 tons total, when operated at 100 lbs. air pressure. Maximum capacity is 60 tons at 125 lbs. air pressure. Stroke of the cushions is adjustable from 0 to 3 inches.

The machine is rated 400 tons and will bend 12' x ½" mild steel between housings. Total length of bed and ram is 16'-0" including 10-inch extensions at both ends. The double plate bed is 20" wide. The ram has detachable brackets on either side. Throat depth is 18". Air-operated ram counterbalances are provided.

Control is air-electric with two foot stations for operation by one or two men. It includes "inch" and "run" with automatic stop at top of stroke. Ram adjustment is motorized. Back gauge has a range of 48 inches and rides on ball bearings. It is motor driven and front operated.

The design of Steelweld brakes simplifies the incorporation of die cushions and various features found helpful for metal forming operations. Therefore, it is possible to include at reasonable cost special features that will speed or aid unusual forming work.

Write for free booklet No. 2023

STEELWELD
Mechanical and Hydraulic
PRESS BRAKES

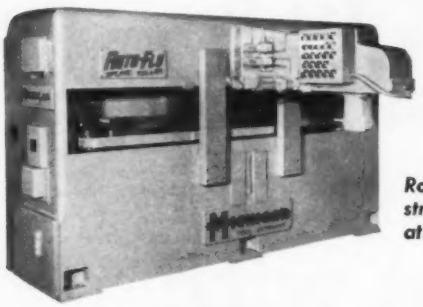
Steelweld Machinery includes: Mechanical & Hydraulic Shears and Press Brakes, One-, Two- and Four-Point Straight-Side Presses, Speed-Draw Presses.

STEELWELD MACHINERY DIVISION • THE CLEVELAND CRANE & ENGINEERING CO. • 5480 E. 281 ST. • WICKLIFFE, OHIO

SOLUTIONS TO GEAR PROBLEMS

PROBLEM: TO BOOST TRACTOR AXLE SPLINE STRENGTH WITHOUT HIGHER COST

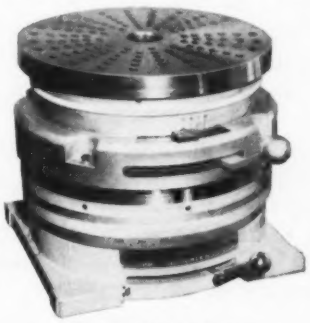
To increase strength of tractor axle shafts produced by a major manufacturer without increasing diameter, Michigan recommended the use of a Roto-Flo machine to cold roll the splines. This resulted in a 60% increase in torque load capacity due to the cold working at the normally weakened section. The "chipless machining" process reduced stress concentrations by 37% and increased production rate three-fold over the slower previous hobbing method. The same machine is used for different sizes of shafts. There were also major savings in tool costs over hobbing.



Roto-Flo gives stronger splines at lower cost

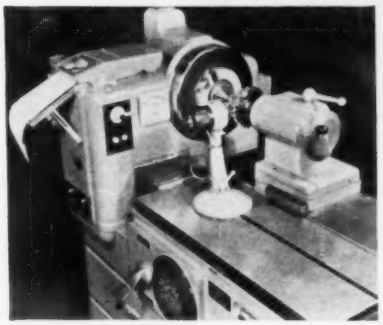
PROBLEM: NEEDED FAST ACCURATE INDEXING IN ¼ DEGREE INCREMENTS

Operations performed on a missile part required extremely accurate indexing in quarter degrees. Precision indexing tables used before required special gage blocks, trigonometry tables and a lot of time. Michigan's answer was a double table version of its Milichex rotary indexing table. This new version, Model M2X-900, provides instant indexing to ¼ degree settings with an accuracy of ¼ second of arc. No gage blocks or trig tables are needed. Operator merely indexes upper and lower tables to proper settings and Milichex automatically locks into exact angular position.



This Milichex indexes in ¼° increments

PROBLEM: 100% CHECK OF GEAR TOLERANCES TO TENTHS IN PRODUCTION

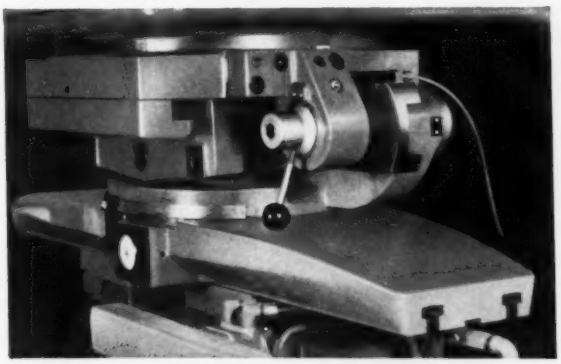


Production lead checking to laboratory tolerances on a 1218-A

A jet engine production bottleneck was the time required to accurately check the lead angle of gears to 0.0003 inch. A Michigan Sine Line 1218-A Lead Checker answered this need. Originally a 'laboratory' type checker, the machine with its precision optical system eliminates the need for "operator feel", records all checks, has the ruggedness for continuous production checking.

PROBLEM: TO SHAVE ANY COMBINATION OF CROWN & TAPER ON SAME MACHINE

Solved by a compact attachment for the Mark II shaving machine. Setting permanently installed attachment to scale controls amount of taper. An eccentric bushing in the attachment controls taper independently. For uncrowned untapered gears, both are set to 'zero'. Gears can be tapered or crowned with either transverse or modified underpass method. For spur gears, underpass method can also be used.



Taper & crown attachment for the Mark II gear shaver

MICHIGAN TOOL COMPANY, 7171 E. McNICHOLS RD., DETROIT 12, MICHIGAN

Right to a thousandth when you adjust with LAMINUM®

Just *p-e-e-l* the laminations—it's that easy to get accurate assemblies with LAMINUM . . . even as close as a thousandth. No machining. No grinding. No counting. No stacking. No miking. And no need for stand-by equipment.

LAMINUM is versatile, too. You have a choice of brass, mild steel, stainless or aluminum . . . of .002″ or .003″ laminations . . . of plastic bond or metallic bond.

Whatever your choice, we'll custom-stamp LAMINUM to your own rigid specifications . . . any size, any shape, and quantity . . . to look and act like solid metal . . . to help you produce more and better assemblies . . . in less time . . . and at less cost.

That's what makes LAMINUM so practical. So popular. So easy to use. Revised SHIM DESIGN FOLDER No. 4 gives complete up-to-the-minute engineering data. Send for your copy today.

THE LAMINATED SHIM COMPANY, INC.
Home Office and Plant
3904 Union St., Glenbrook, Conn.

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600 Sixteenth St., Oakland 12, Calif.

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- **Technical-Document Collection Grows**
- **Radioactivity Tests Tool Wear**

Keeping up with Washington

Loring F. Overman

SPONSORS of tax-incentive plans for encouraging business expansion are confident that favorable action will be taken by the present Congress. If so, it will culminate years of effort on the part of the Machinery and Allied Products Institute, the National Machine Tool Builders' Association, the National Association of Manufacturers, and other business organizations.

Particularly significant was President Kennedy's announcement that Congress would soon be asked to consider such a tax-incentive program.

"New plant investment," said the President, "not only means expansion of capacity, it means modernization as well. Gleaming new factories and headlines about automation have diverted our attention from an aging industrial plant. Obsolescence is slowing down our growth, handicapping our productivity, and worsening our competitive position abroad.

"Nothing can reverse our balance of payment deficit if American machinery and equipment cannot produce the newest products of the highest quality in the most efficient manner. The available evidence of the age of our industrial plant is unofficial and fragmentary, but the trend is unmistakable; we are falling behind.

"The average age of equipment in American factories is about nine years. In a dynamic economy, that average should be falling as new equipment is put into place. Instead, the available evidence suggests that it has been slowly rising.

"Private surveys of machine tools used by manufacturers of general industrial equipment found less than half of those tools over ten years in 1949, but over two-thirds above that age in 1958. Nineteen per cent of our machine tools were found to be over twenty years old.

"Meanwhile other countries have been lowering the average age of their fixed capital. The German example is the most spectacular. Their proportion of capital equipment and plant under five years of age grew from one-sixth of the total in 1948 to two-fifths in 1957.

"All of these facts point in one direction: we must start now to provide additional stimulus to the modernization of America's industrial plant. Within the next few weeks I shall propose to the Congress a new tax incentive for businesses to expand their normal investment in plant and equipment."

Meanwhile (back in Congress) there are those who reverse some of the steps taken in the past in the hope of improving the lot of those who must compete with imports. Senator Gore (D. Tenn.), member of the Finance Committee, introduced a bill to repeal the foreign tax credit and to tax the earnings of foreign subsidiaries in the year earned, whether or not repatriated to the United States. Senator Gore said that the present method of taxing foreign income "is weighted heavily in favor of foreign investment and against domestic investment."

Metals Research Published

Two bulletins issued by the Defense Metals Information Center report improved techniques for machining high-strength steels. They are available through the Office of Technical Services, Department of Commerce, Washington 25, D. C. Methods of machining hardened steels with carbide, ceramic, and high-speed-steel tools are described; and information is given pertaining to proper feeds, speeds, and depths in a bulletin entitled "Turning of High-Strength Steels in the Hardness Range of 330 to 560 Brinell."

Another helpful publication, "Selected References to ASTIA Documents on Machining," presents a survey of literature on machining of high-strength metals, listing 132 publications selected from the collection of the Armed Services Technical Information Agency.

Technical-Document Collection Grows

Since its beginning in 1945, OTS has amassed a collection of some 200,000 technical documents, and about 900 are added each month. The department is the Government's center for the collection and distribution to the public of technical reports growing out of research financed by various agencies. Reports of wide interest are sold in printed form; the more specialized and limited-interest reports are available in microfilm and photocopy.

These reports, sometimes offered for pennies, may represent the expenditure by a government agency of many thousands of dollars in research. As a typical example, a company recently revealed that two reports of research on a metallurgical process purchased from OTS for 50 cents saved the company $20,000 to $25,000. One large machinery company reports saving thousands of dollars in experimentation and research by using the OTS services.

Radioactivity Tests Tool Wear

Measurements comparing conventional machine tools with machines applying radioisotope-activated techniques are the subject of a report issued by the Atomic Energy Commission. The isotope techniques provide a reasonably precise indication of wear rates, the report states, but it is doubtful if this data can be used to estimate the tool's total performance. The sixty-seven-page report is entitled "Evaluation of the Radioactive Tracer Technique for Use in Tool-Wear Studies."

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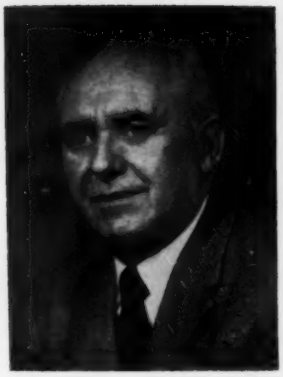
Machinery
APRIL 1961



It's a Wonder Any Missile Flies!

RELIABILITY—that comparatively new term being increasingly adopted by branches of the metalworking industry—usually refers to the likelihood of non-failure in the performance of an assembly component. At first, many engineers looked upon reliability programs as a fad or fetish of scientists that would one day be relegated to the same limbo as "technocracy."

Reliability is here to stay—make no mistake about that! It is absolutely essential in the fields of electronics and missiles and anywhere else that large numbers of intricate parts are combined in complex assemblies.

Let's say that a part has a reliability of 99 per cent. This means that past experience with the part indicates proper functioning 99 times out of 100—in other words, 1 failure out of 100 times the part was operated. Assemble that part with 399 other components possessing the same degree of reliability to obtain a mechanism with 400 working parts. The reliability of this assembly would be 0.99 to the four-hundredth power, or an unacceptable 2 per cent.

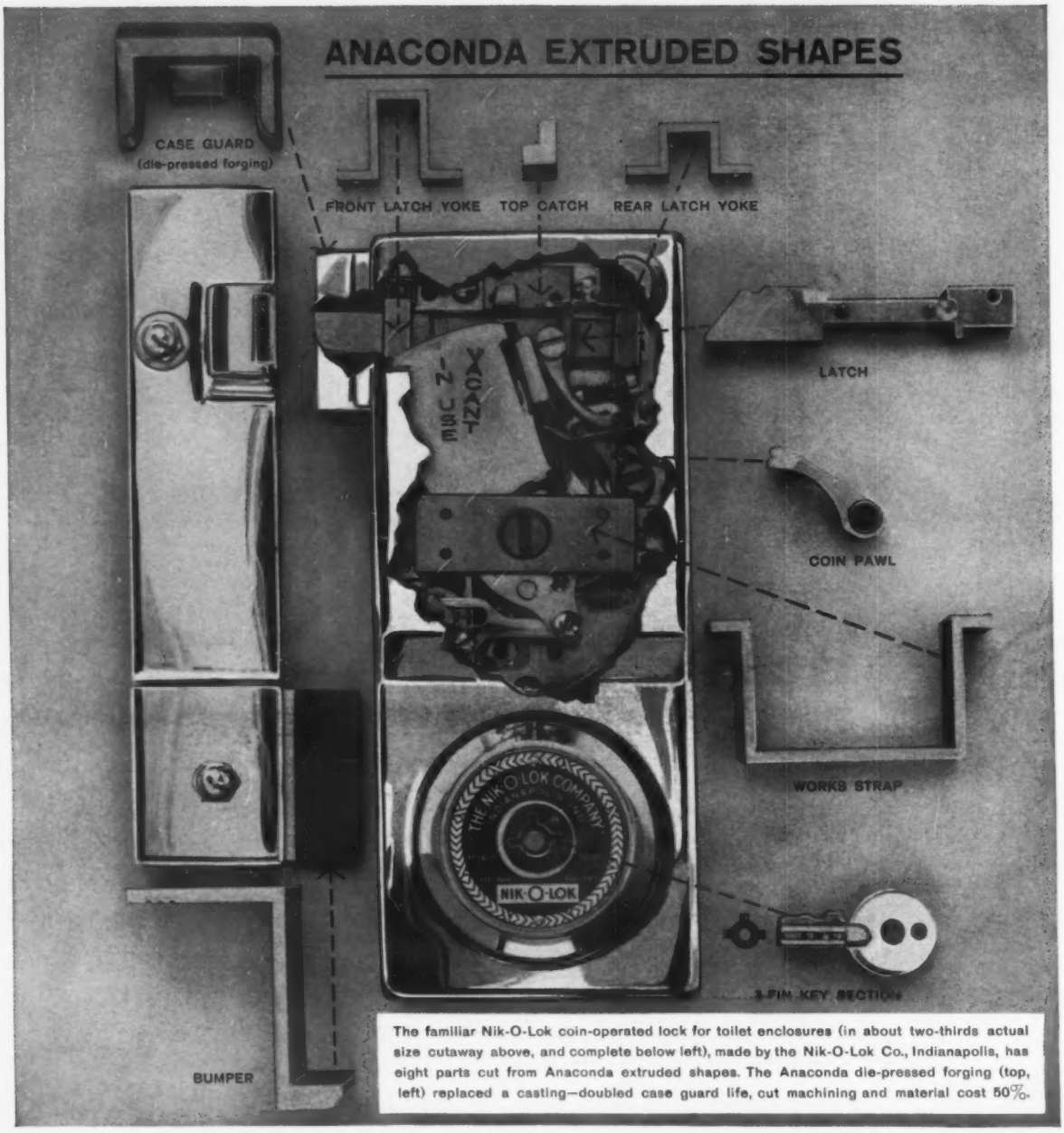
Consider now the fact that an Atlas intercontinental ballistic missile has 300,000 separate components. Assuming that all of these parts are of vital importance to satisfactory flight, they must all have a reliability of 99.99996 per cent if Atlas missiles are to reach their target nine times out of ten. It has been pointed out that if the Atlas 300,000 parts had a reliability of 99 44/100 per cent—the claimed purity of Ivory soap—not a single missile would ever reach its mark.

If the lay public understood the nature of missile and satellite requirements, it would not be critical of flight failures. Rather it would marvel that any missile could be put into successful flight.

Reliability programs have been so successful in the missile industry, it is no wonder that they have now been established also for more prosaic things like automobiles and other products which embody mechanisms. No question about it—reliability with its new concepts of quality control is here to stay.

Charles O. Herb

EDITOR



The familiar Nik-O-Lok coin-operated lock for toilet enclosures (in about two-thirds actual size cutaway above, and complete below left), made by the Nik-O-Lok Co., Indianapolis, has eight parts cut from Anaconda extruded shapes. The Anaconda die-pressed forging (top, left) replaced a casting—doubled case guard life, cut machining and material cost 50%.

How parts sliced from long lengths of "premachined" brass shapes cut costs. It starts in design. You select cross sections which minimize subsequent machining—and scrap. The only limitation is that grooves, slots, etc., must parallel the axis of the extruded bar. The smooth surface of extruded shapes reduces many finishing operations. And high dimensional accuracy simplifies assembly. In addition, you get superior, long-wearing parts that improve the quality of your product, because of the strong, homogeneous wrought-metal structure of extruded shapes. For imaginative and practical help in adapting extruded shapes to the economical production of intricate parts, see your Anaconda representative. Or write: Anaconda American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario.

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Submerged-Arc Welding of Stainless Steel

Following reference material is from a forthcoming handbook to be published jointly by the American Welding Society and the Committee of Stainless Producers, American Iron and Steel Institute

IN many respects, submerged-arc welding of stainless steel resembles the welding of carbon steel. The same equipment, precautions, and techniques developed for carbon steel apply to stainless steel, with minor modifications. Uniform welds of excellent appearance may be made under a variety of conditions. However, unless certain metallurgical principles and requirements peculiar to stainless steel are understood and followed, serious malpractice may result even though quality materials are used and workmanship is excellent.

During the 1950's, the submerged-arc process became more versatile and acceptable for the welding of stainless steels. Through the efforts of many investigators, certain metallurgical deficiencies encountered earlier are now more clearly defined and are gradually being overcome. Most of these deficiencies are now fully explainable in terms of the effects of weld-metal composition and microstructure on: properties and soundness, corrosion resistance, and behavior at elevated temperatures. The same basic relationships apply equally to the submerged-arc and other processes. Any differences are in degree only, and usually result from the higher heat input, larger weld nugget, and slower solidification and cooling rates normally associated with the submerged-arc process.

The beneficial effect of delta ferrite in the weld structure on suppression of hot shortness or fissuring applies to submerged-arc as well as to the other processes. As the heat input during welding increases, however, the weld nugget becomes larger and solidification rates are reduced. Both effects promote increased segregation of alloying

elements and increased variation in microstructure. Consequently, the submerged-arc weld may require a higher average ferrite content than the shielded metal-arc or other processes in order to avoid ferrite-depleted areas which are subject to microfissuring. The deposit is thereby rendered more prone to sigma phase embrittlement. Although extensive quantitative data are lacking, it is generally believed that submerged-arc welds are more susceptible than others to hot shortness or fissuring when the weld structure is fully austenitic. This is alleged to result partly from the larger size, reduced solidification rate, and more pronounced segregation. This apparent deficiency of the submerged-arc process may also result from the presence in the weld of certain impurities and alloying elements. Silicon, sulphur, and especially phosphorus tend to promote hot shortness in fully austenitic welds, whereas increased carbon and manganese contents, within limits, are beneficial. With the submerged-arc fluxes presently available, considerable silicon can be transferred to the deposit due to high-temperature slag-metal reactions; and although it can be minimized by choice of flux and welding technique, the silicon content with submerged-arc is appreciably higher than with other processes. Pickup of phosphorus from the submerged-arc

Submerged-arc welding plays a vital part in atomic reactor construction. The 20-foot diameter stainless-clad reactor housing for the Dresden, Ill., power station, preheated to 300 degrees F., is being welded by a Linde Unionmelt UHU-2 dual-head setup at New York Shipbuilding Corporation. ***(Photo, courtesy of Linde Company)***

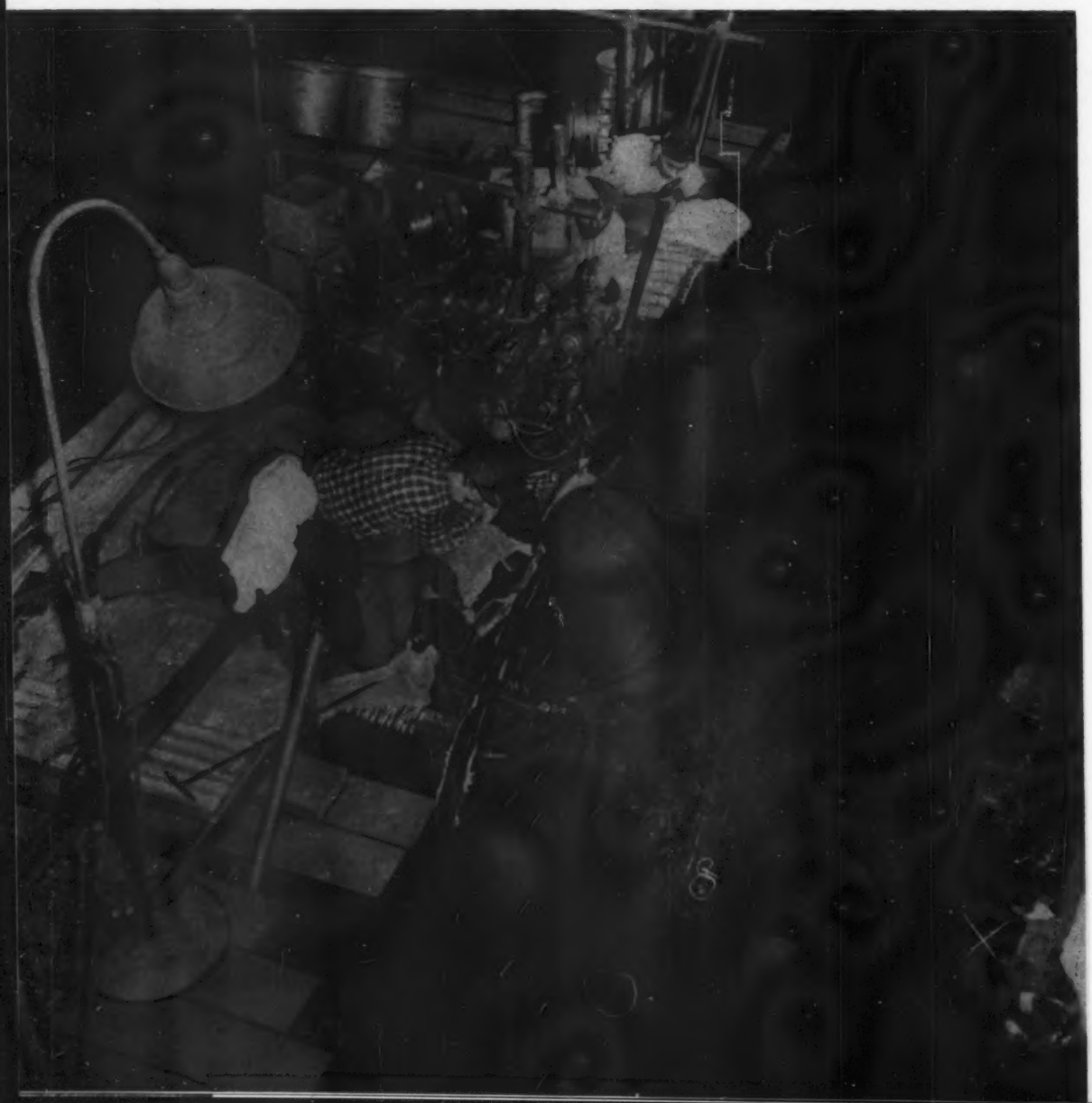

Table 1. Fatigue Properties of Submerged-Arc Welds (Rotating Beam)

Weld No.*	Condition	Ultimate Strength, psi	Yield Point, psi	Elongation in 2 Inches, Per Cent	Reduction in Area, Per Cent	Charpy Impact, Foot-Pounds†	Limiting Stress, 10,000,000 Reversals, psi
1	As-Welded	62,700	43,000	30.7	57.0	36.5	32,000–35,000
1	Stress-Relieved	59,200	35,000	35.5	66.0	33.5	32,000–35,000
1	Normalized	54,700	32,700	39.0	67.5	36.8	32,000–35,000
2	As-Welded	68,200	47,100	28.7	51.5	25.8	35,000–38,000
2	Stress-Relieved	63,000	37,700	33.7	63.8	31.2	35,000–38,000
2	Normalized	60,250	38,200	35.8	64.0	32.5	35,000–38,000

* Weld No. 1, rimmed steel, 2 inches thick (ASTM A-285C). Weld No. 2, silicon-killed steel, 2 5/16 inches thick (ASTM A-201A).
† Charpy impact tests made at room temperature using keyhole notch.

slag or from base-metal dilution can also occur and is even more harmful.

Some Limitations

For these reasons, the submerged-arc process is not commonly used for those applications requiring a weld deposit which is either fully austenitic or of a low, controlled ferrite content, not exceeding about 4 per cent, and at the same time requiring a high degree of soundness and freedom from hot shortness. Typical examples are heavy-wall steam piping, valves, and other critically stressed parts which are designed for a long service life under creep at temperatures sufficiently high for sigma-phase embrittlement, stress rupture, and other factors to be of concern. These present limitations do not appear to be inherent to the submerged-arc process and may eventually be overcome by further improvement of flux-formulation, development of procedures to promote uniformity of weld microstructure, and other advances.

High-quality submerged-arc welds are commonly obtained with the proper use of existing techniques and welding materials for those applications which permit a ferrite content in the weld deposit of about 4 per cent or more. For these applications, the only questions governing the choice of welding process are those of economy and practical capability. Mechanical properties of such submerged-arc welds appear to be fully comparable to those made by other processes, provided the comparison is made on the basis of similar composition and microstructure. Comparable mechanical properties include strength and ductility at room temperature and the retention of ductility or notch toughness at sub-zero temperatures, Table 1. To minimize embrittlement at low temperature, it is important, as when using other processes, to keep the carbon and nitrogen contents of the weld as low as is practicable, and to maintain the ferrite content at the lowest level consistent with soundness. Lowering the heat input, by increasing the travel speed or by lowering the welding current and arc voltage, will reduce the loss of corrosion resistance due to carbide precipitation.

Welding Techniques, Joint Design, and Equipment

Table 2 lists typical mechanical properties of submerged-arc welds in stainless steel. It should be understood, however, that these properties are typical only of joints made in strict accordance with the best possible practice, using selected welding materials and techniques which maintain the actual chemical composition and ferrite content of the weld deposit within quite narrow limits.

Though typical joint designs and weld settings apply to carbon steel, they are useful as a first approximation for the welding of stainless steel. Under identical conditions the deposition rate and cross-sectional areas of the bead are increased about 20 to 30 per cent with stainless steel. However, a change from one grade of flux to another can result in an equal difference in deposition rates with either material.

Compared to carbon steel, the higher electrical resistance of stainless steel adds to the difficulty of maintaining uniform contact and transfer of welding current from the contact tip to the electrode. For the same reason, the length of electrode extension beyond the contact tip becomes more critical. This extension governs the amount of resistance preheating of the electrode and can appreciably affect the deposition rate.

Filler Metals and Base-Metal Dilution

Nine standard grades of austenitic stainless-steel bare electrodes are listed in AWS Specification A5.9-53T, Table 3. This specification covers bare electrodes and welding rods for both the submerged-arc and gas-shielded processes. It includes chemical composition requirements for

the filler metal only, and does not specify either mechanical test or composition requirements for deposited metal.

Weld-deposit composition can be greatly altered from that of the filler metal by the flux used, changes in welding technique, base-material composition, amount of dilution, and other typical welding parameters. All of these factors vary with different applications and do not lend themselves, at present, to standardization, Table 4.

Due to practical necessity, the composition ranges listed in this specification are broad. Since composition has such a profound effect on the quality and serviceability of the weld, a like variation cannot always be tolerated in the deposit. To maintain control, it may be necessary for the user to alter welding technique or the alloy content of the flux, or to take other steps to compensate for variations in filler-wire composition.

Filler-wire specification is reviewed frequently and revised or expanded periodically. Special grades and new or proprietary alloys are also available for submerged-arc welding. Information on these can be obtained from suppliers.

Selection of Flux

Submerged-arc fluxes—known as melt, flux, or welding composition—are now available from a number of suppliers as proprietary materials. In the absence of standard specifications, close liaison between the supplier and the user is advisable for critical applications such as the welding of stainless steel. These materials fall into two categories, according to method of manufacture. The fused type, known as melt, is a glasslike material produced by melting the ingredients at a high temperature and then granulating the product after solidification. The sintered type, variously known as agglomerated or bonded flux, is produced by mixing the ingredients with a suitable binder, and firing or baking the mixture to achieve granular particles, each containing the same proportions of the original ingredients. Alloying elements such as chromium, nickel, molybdenum, and columbium are commonly added to the weld deposit by incorporating them in the flux. Because the lower temperatures involved in manufacture reduce the degree of oxidation of such metallic ingredients, the sintered materials are much better adapted for adding alloying elements than are the fused fluxes.

When these alloying additions are omitted from grades suitable for stainless-steel welding, the material is termed a neutral flux, as opposed to alloy fluxes. The term "neutral" is relative, since all commercial grades alter the alloy contents of the weld by a mechanism resembling high-temperature slag-metal reactions in steelmaking. With these neutral fluxes, the iron and nickel content of the undiluted weld is sometimes greater than in the filler metal, due to the loss of chromium and other elements during welding. Recovery of iron exceeds that of the following

Jet blade-retainer bands are welded in place on the turbine wheel web, using a manual Lincolnweld unit with 18-8 stainless wire and ST-100 flux, at the Solar Aircraft Co.

(Photo, courtesy of Lincoln Electric Co.)

elements listed in relative order of per cent recovery: molybdenum, chromium, vanadium, columbium. Percentage molybdenum content of the undiluted weld is frequently about the same as that in the filler metal, since its recovery is only slightly less than iron recovery. Chromium, vanadium and columbium contents in the undiluted weld are invariably reduced.

Flux Changes the Picture

Formerly, these losses in alloying elements severely limited the use of submerged-arc welding on stainless steel. With the availability of alloy fluxes, these losses are no longer an obstacle. With all fluxes presently marketed in this country, silicon is transferred to the deposit in amounts which may or may not be objectionable, depending on the alloy type, application, and welding technique. This results from oxidation-reduction reactions between the alloying elements that are lost and silicon oxides present in the slag. Metallic silicon is transferred to the weld, and the oxidized alloying elements, to the slag. The extent of this reaction and the resultant silicon pickup is reduced by lowering the amount of silicon compounds in the flux. This has been one objective in the development of fluxes for stainless steel.

Investigations have shown that these slag-metal reactions are affected by welding technique. Evidence indicates that most of the reaction occurs during passage of the filler metal across the arc rather than in the molten puddle. With a neutral flux, silicon content increases when travel speed is reduced or the arc lengthened, while per cent recovery of chromium increases with decreasing arc length or increasing travel speed. With alloy fluxes the relationships are much more complicated. If the alloy flux contains a large addition of chromium, an increased arc length may raise the chromium content of the weld even though per cent chromium recovery is reduced. This is because the longer arc melts a greater amount of flux and provides enough additional chromium to offset the reduced efficiency of transfer. Other variables—such as welding current, electrode diameter, and electrode inclination—can also affect recovery and transfer of alloying elements. Specific information on the effect of variables may be obtained from flux suppliers for given applications.

Adding Elements via Flux

Recovery of titanium and aluminum with fluxes presently available is poor, particularly with aluminum. As a result, neither is important as an alloying element in stainless-steel submerged-arc welds. Furthermore, their presence in the electrode will promote additional transfer of silicon to the weld. Future developments may permit their use as effective alloying elements in submerged-arc welds. Many alloy elements can be added efficiently through the flux; these include

Table 2. Typical Mechanical Properties of Welds in Stainless Steel

	AISI Type 304, 7/8 Inch Thick		AISI Type 347, 3/4 Inch Thick		AISI Type 309 SCB, 3/8 Inch Thick	AISI Type 430, 1/2 Inch Thick
	As-Welded	Water Quenched 1950 Degrees F.	As-Welded	Stress-Relieved 1550 Degrees F.	As-Welded	Heat-Treatment*
0.505 All Weld Metal Tension Test						
Yield point, psi	41,000–43,500	31,000–44,000	43,900–45,000	37,500	41,800	59,700
Ultimate strength, psi	83,000–84,800	83,000–97,500	83,400–84,500	87,000	80,000	75,700
Elongation in 2 inches, per cent	51–55	49–58	38–41	46	45.3	28.0
Reduction in area, per cent	60–62	43–65	44–52	60	54.5	.....
Transverse Tension Test						
Yield point, psi	.....	.....	....	.....	.....	37,500
Ultimate strength, psi	.....	.....	.....	.....	.....	72,000
Failure	.....	.....	.....	.....	.....	Base metal
Free-Bend Test						
Elongation, per cent	43–52	49–54	40	.....	60	70.7
Hardness						
Rockwell	.....	.....	.....	.....	.....	Rb 82–84
Charpy Impact†						
Notch in Center of Weld						
Room temp., foot-pounds	38	36	31	28	32	.....
−320 degrees F., foot-pounds	26–30	28	17	17	.....	.....
Notch in Heat-Affected Zone						
Room temp., foot-pounds	55	50–63	41	36	.....	.....
−320 degrees F., foot-pounds	36–42	41–47	47	27	.....	.....

* Heat-treat at 1425 degrees F. for four hours and slow cool.

† Each value average of three to nine tests. 10 × 10 mm. Specimens prepared according to Par. U-142 of ASME Boiler Code.

Stainless J47 turbo-jet engine burner plate is joined to its mounting ange by Type 347 welding wire deposit. Flux is fed by hose on the left. Operator at right picks up excess flux behind the weld, using vacuum nozzle, at Solar Aircraft Co. *(Photo, courtesy of Lincoln Electric Co.)*

Table 3. Chemical Requirements for Corrosion-Resisting Steel Welding Rods and Electrodes

AWS-ASTM Classification Number	Carbon, Per Cent	Chromium, Per Cent	Nickel, Per Cent	Molybdenum, Per Cent	Columbium plus Tantalum, Per Cent	Manganese, Per Cent	Silicon, Max., Per Cent	Phosphorus, Max., Per Cent	Sulphur, Max. Per Cent
ER 308	0.08 max.	19.5–22.0*	9.0–11.0	...	...	1.0–2.5	0.60	0.03	0.03
ER 308L	0.03 max.	19.5–22.0*	9.0–11.0	...	...	1.0–2.5	0.60	0.03	0.03
ER 309	0.12 max.	23.0–25.0	12.0–14.0	...	...	1.0–2.5	0.60	0.03	0.03
ER 310	0.08–0.15	25.0 min.	20.0 min.	...	...	1.0–2.5	0.60	0.03	0.03
ER 316	0.08 max.	18.0–20.0	12.0–14.0	2.0 –2.5	...	1.0–2.5	0.60	0.03	0.03
ER 316L	0.03 max.	18.0–20.0	12.0–14.0	2.0 –2.5	...	1.0–2.5	0.60	0.03	0.03
ER 317	0.08 max.	18.5–20.5	13.0–15.0	3.25–4.0	...	1.0–2.5	0.60	0.03	0.03
ER 330	0.15–0.25	15.0–17.0	34.0 min.	...	...	1.0–2.5	0.60	0.03	0.03
ER 347	0.08 max.	18.5–21.0*	8.5–10.5	...	10×C min., 1.00 max.	1.0–2.5	0.60	0.03	0.03
ER 410	0.07–0.12	12.0–14.0	0.6 max.	0.6 max.	...	0.6 max.	0.50	0.03	0.03
ER 420	0.25–0.40	12.0–14.0	0.6 max.	...	...	0.6 max.	0.50	0.03	0.03
ER 430	0.10 max.	15.5–17.0	0.6 max.	...	...	0.6 max.	0.50	0.03	0.03
ER 502	0.10 max.	4.5– 6.0	0.4 max.	0.45–0.65	...	0.6 max.	0.60	0.03	0.03

* Chromium, min. = 1.9 × nickel.

NOTE: Analysis shall be made for the elements for which specific values are shown in this table. If, however, the presence of other elements is indicated in the course of routine analysis, further analysis shall be made to determine that the total of these other elements, except iron, is not present in excess of 0.70 per cent.

chromium, nickel, molybdenum, columbium, carbon, manganese, vanadium, tungsten, cobalt, and copper. Certain brands of flux, used primarily for welding carbon steels, contain a high proportion of manganese and silicon oxides. If these acid fluxes are used for welding stainless steel or any other high-chromium alloy, the loss of chromium and the pickup of both silicon and manganese are very high and there is an excessive entrapment of inclusions in the deposit.

Control of base-metal dilution can be the most important single factor in submerged-arc welding of stainless steels. In this process, base-metal dilution can vary within an extremely wide range, from less than 10 per cent to as much as 75 per cent, exceeding that of any other consumable-electrode process. It is usually desirable, and sometimes mandatory, to maintain weld-deposit composition within narrow ranges. To avoid hot shortness, these desired ranges are normally those which provide a moderate, controlled amount of delta ferrite in the weld structure. As explained earlier, an excess of ferrite can lead to embrittlement or loss in corrosion resistance. Obviously, a change in the percentage of base-metal dilution causes a corresponding change in weld-deposit composition, unless the base-metal and undiluted weld compositions happen to be identical. Frequently there is an appreciable difference between stainless-steel base-metal and weld compositions, even when both are the same nominal alloy grade. The relative importance of a given change in dilution varies enormously with the materials involved in the joint, and is best evaluated by use of the Schaeffler constitution diagram and dilution direction lines. A desired structure of austenite plus a moderate amount of ferrite can sometimes be very difficult to maintain with the submerged-arc process.

The two-wire series-power technique, and the "spread arc" method in which one or more electrodes are automatically weaved at right angles to the travel direction, are widely used. Further information is available from suppliers of welding equipment and materials. With either technique, low dilution is dependent upon the "cushioning" effect of the weld puddle under the arc, and is maintained only by rigid control of procedure variables.

These low-dilution techniques are widely used for overlay cladding of carbon and low-alloy steels to obtain a corrosion-resistant stainless-steel surface. This is done economically over large surface areas of forgings, castings, and even on heavy gage wrought products where other cladding processes compete. Several alloy grades have been successfully deposited, including Types 304, 308, 309, 316, and 347. To minimize fissuring with fully austenitic deposits such as Type 310, the utmost care is required in selecting filler wire and flux, and even in controlling the base-metal composition. As in other processes, silicon and phosphorus content should be kept as low as practicable, and carbon maintained on the high side of the permissible range. Severe fissuring can be expected in fully austenitic overlay deposits if the previously mentioned precautions are violated. Even though dilution of 10 per cent or less is possible with refined techniques, many users have preferred to compensate for a somewhat higher dilution by using either a higher alloy filler metal or alloy fluxes. To obtain a Type 308 deposit with multiple-electrode techniques, various combinations of Type 309, 312, 310, and 308 electrodes have been used with and without alloy fluxes for deposition of the first layer. For multiple-layer deposits, a matching filler metal is normally used after the first layer.

Stainless-steel overlays on carbon or low-alloy steels are subject to the same problems as butt joints betwen dissimilar metals. Carbon migration across the fusion line into the stainless deposit can occur upon exposure to elevated temperature. Stresses from mismatch in thermal expansion are concentrated near the fusion zone, which, as in the dissimilar metals joint, constitutes a metallurgical notch. Furthermore, when thick multiple-layer overlays are deposited on heavy restrained sections, the shrinkage stress introduced in the deposit and adjacent base metal should be considered as a factor in engineering and procedural arrangements.

Table 4. Filler Metals Recommended for Common Austenitic Chromium-Nickel Stainless Steels

Base-Metal Types	Filler-Metal Designation
301, 302, 304, 308	ER308
304L	ER308L
309	ER309
310	ER310
316	ER316
316L	ER316L
317	ER317
330	ER330
321	ER321
347	ER347
17-7PH	W17-7PH
PH15-7 Mo	WPH15-7 Mo
17-4PH	17-4PH
AM350	AM350
AM355	AM355
A286	A286
201	ER308
202	ER308

Contest for

Photo, Courtesy of The Garrett Corporation

ENGINEERS have proved that closer tolerances mean a better product, and that management must produce it not only to maintain its position in the market place, but also to better it. Every day, in one plant or another, production blueprints specifying fine tolerances in the fourth decimal place come down to the shop for the first time. Tolerances of 0.0002 and 0.0001 inch are becoming as common today as those of 0.002 and 0.001 inch were only a few years ago.

But, given the "tenth," where is that implicit millionth? The science of quality control has shown that for adequate control of a tolerance, the means for measurement should discriminate at least to one-seventh of that tolerance. Gage makers, however, have adopted the more convenient figure of one-tenth. For example, if a gage is to measure a size difference of 0.0001 inch accurately, its own tolerance must be in terms of 0.00001 inch.

Going a step further, the gage, in turn, must be checked with a master standard, Fig. 1. The nominal size of this standard must be, therefore, within a tolerance of 0.000001 inch if the part tolerance is 0.0001 inch and the gage tolerance is 0.00001 inch. The millionth enters the picture!

At the present state of the art, however, a master standard cannot be made to one-millionth accuracy. Thus the theoretical rule cannot be followed in this case and some compromise must be made. General practice is to broaden the tolerance of the master to a practical figure and make a corresponding reduction in the tolerance of the gage so that the combination will represent an accurancy that is still one-tenth that of the part tolerance, or as close to that figure as possible.

Progressive industries are now accepting the proven thesis that the reliability of an end product is directly dependent on the reliability of the measurement standards under which it is manufactured. Tools and machines have been refined to the point where many are capable of sizing to millionths of an inch. Gaging equipment that can see the millionth difference in dimension has been on the market for some time. Winning at "measurement chess" today depends to a great extent on the skillful use of this equipment.

Dirt *vs.* Cleanliness

To demonstrate the way all dirt perverts precise measurement, a simple experiment can be made. Thoroughly clean a gage-block, using a clean, lint-free chamois with a filtered solvent such as alcohol, and similarly polish the anvil of a millionth comparator. Place the gage-block in the comparator, eliminating other possible errors such as temperature change and wringing, and set the instrument to its zero reading.

Now remove the block and, in the traditional manner, wipe it "clean" with the palm of the hand. Also give the gage anvil the customary

Precision

FRANK PARDEE, Gage Engineer
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hand smear. When the gage-block is returned to the comparator it will be found that its thickness has increased by as much as 0.000005 inch.

The list of dirt bearers is legion: hands, work clothing, scuffling shoes, window ledges, tote boxes, bench tops, rags, tobacco ashes, coolant, the air we breathe.

Temperature Transfer *vs.* Control

There are other reasons for keeping manual handling of both work-piece and gage to an absolute minimum. One of these is the matter of gaging temperature.

It is well known that metal pieces increase in size when they are warmed up. But what is not so generally realized is how fast a part or a gage can absorb heat from handling, and how long it takes to cool down to room temperature. The frame of an 8-inch micrometer will expand about 0.0015 inch in five minutes when gripped in the normal way, but it must be put down for one-half hour to return to normal size.

Sunlight pouring in a window and the straight line infrared rays from hot radiators are so commonplace that the speed with which they can heat an object is often overlooked. As for the casual cold draft, its mass cooling effect can shrink a casting several ten-thousandths of an inch in a few seconds.

Many plants have recognized the potential error of uncontrolled temperature by investing in air conditioning—some of them rather expensive installations, but surely necessary for precision checking of brass and aluminum parts with steel gages and masters. For that last millionth in accuracy, temperature control should be in the neighborhood of 0.1 degree.

On the other hand, temperature control adequate for many circumstances can be had by observing two rules. First, place the work-piece, master, and gage in the same temperature environments long enough to allow their temperatures to equalize. This may take a few minutes to many hours—depending on measurement accuracy required. Second, shelter or box-in the immediate work area. It is surprising how constant the temperature remains inside an ordinary corrugated cardboard shipping carton, for example. The effect of body heat can be neutralized by working around a clear plastic shield with insulated forceps as is being done in Fig. 2.

Deflection *vs.* Correct Gaging Pressure

Magnitude of the measurement error caused by deflection often goes unnoticed. Without going into detailed calculations, it can be said that the deflection of gage mountings and frames is proportional to the amount of gaging pressure applied to, or by, the work-piece.

Deflection can be shown as a prime source of gaging inaccuracy by performing the simple experiment suggested in Fig. 3. A sensitive, high-magnification indicator *A* is mounted so that it contacts the support arm as shown. When the work-piece *B* is repeatedly moved into gaging position under indicator *C*, variations proportional to gage deflection will be noted on indicator *A*.

These variations, however, cannot be used to calculate true work-piece size. A more accurate compensation for gage deflection can be applied. First, record the amount of deflection observed on indicator *A* with a master in the gage. Then record the deflection with a work-piece in the

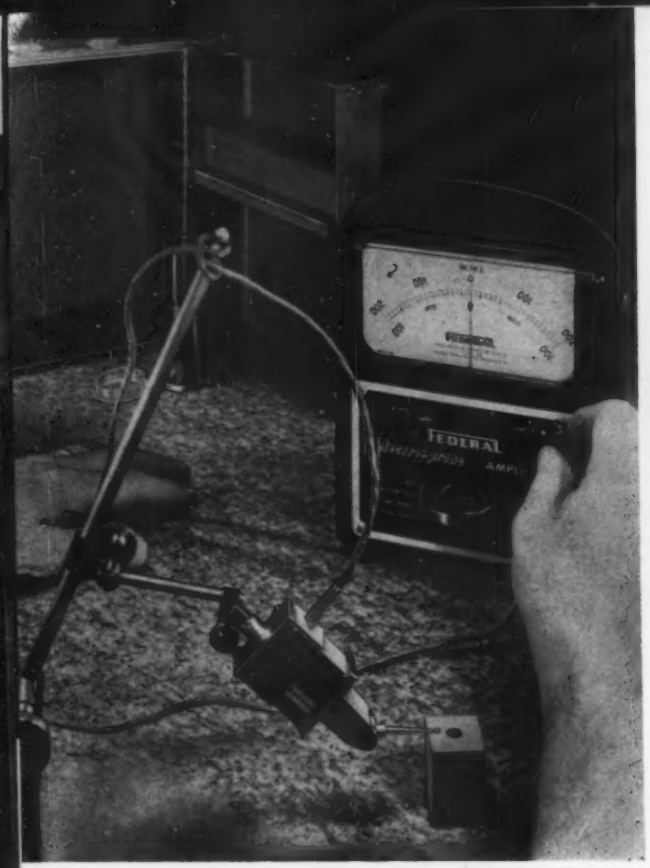


Fig. 1. (Left) Gages whose tolerances are on the order of 0.00001 inch (if they are to accurately measure size differences of 0.0001 inch) must be checked regularly. This electronic gage is being checked against a master standard.

Fig. 2. (Above) The speed with which a gage or part absorbs heat, and the reluctance with which it dissipates that heat, is not generally realized. One way to prevent possible inaccuracy due to effect of body heat is to work with insulated forceps from behind a plastic shield.

gage. The difference between the two readings will be a close indication of the actual error caused by gage deflection.

One countermove against deflection error is to see that all gage mountings are tightened securely. Also, if there is any choice, select the gage with the greater mass of framework and stronger cross-sectional area.

Undue gaging pressure often, if not usually, distorts the work-piece and induces additional error. It is not too uncommon an experience to see a worker literally expand a hole diameter by using a plug gage as he would a mandrel, or burnish a thread to size with a thread ring gage. According to the Bureau of Standards, 6 ounces of pressure applied to a spherical contact on the surface of a gage-block will compress, bend, or deform the block approximately 0.000003 inch.

It follows that the best solution to most deflection-distortion problems is to use as little gaging pressure as possible. Operators heavy-handing plug and snap gages—creasing the work under pressures from 2 to 10 pounds—is an old story. Everyday "miking" builds up at least 2 pounds of pressure.

On the other hand, indicator gages usually make deflection errors negligible because they ordinarily exert pressures of approximately 1 ounce. Electronic transducer gaging heads are available that exert pressures of less than 3 grams, or 0.1 ounce. The deflection errors they cause are undiscernible fractions of a millionth. And proponents of air gaging have no worry over contact pressure deflection.

Gage Wear and Calibration

While gage wear is about the most recognized source of measurement error, it is, at the same time, about the most ignored. If, for example, the anvils of a micrometer or indicating gage are worn back 0.0005 inch, an error of this same magnitude will be read. At the same time wear destroys parallelism, nullifying gage anvil conditions that are often essential to obtaining correct measurement.

Unfortunately, there is no easy formula for determining when a gage is worn. Gage-control systems have struggled with this problem for years. The best answer is to be constantly alert. Plants engaged in the manufacture of parts within 0.0001- or 0.0002-inch tolerances have a definite need to establish, and follow, a gage maintenance routine of a high order.

While maintenance procedures for gage wear should be followed actively, equal attention should be given to the frequent checking of gage setting. It takes only a few moments to check an

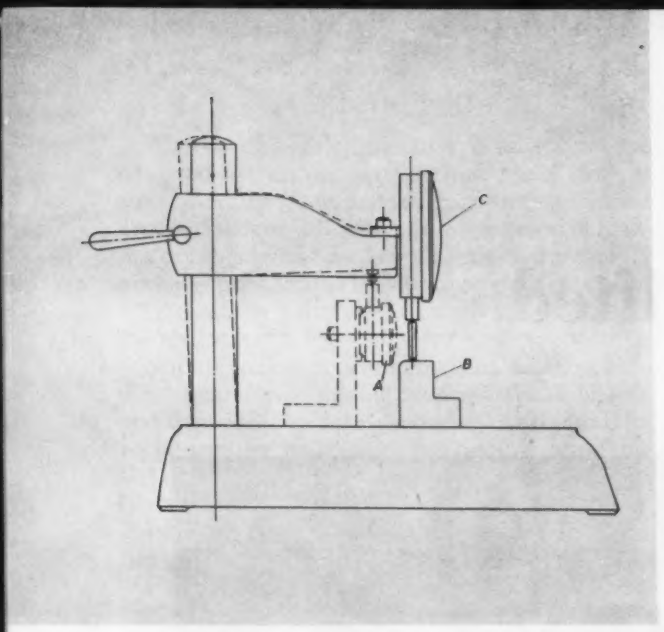


Fig. 3. Deflection of gage mountings and frames, a prime source of inaccuracy, can be positively shown by this experimental setup. Part (B) is moved into gaging position beneath indicator (C). Readings proportional to gage deflection will show up on sensitive indicator (A), which is in contact with support arm.

indicating or electronic comparator with a master. Air gages and bore gages should be regularly rewedded to their master rings. Another point: the fact that gage-blocks and master cylinders and rings have their sizes stamped on them can lead to a false sense of security. When were these masters last calibrated?

Obviously, the effects of human carelessness, indifference, or inattention on the outcome of a precise measurement need not be discussed here. What often fails to be realized, however, is that the worker may not know how to use a particular modern gage correctly. The responsibility for teaching proper gaging techniques should be definitely assigned and continuously lived up to if measurements in the low tenths are to be adequately secured. This instruction could include such basics as correct centralizing; avoiding parallax; selection of reference locations; effect of work-piece geometry such as taper, ovality, squareness; as well as gage range and capacity limitations.

Definition of Gage Characteristics

In selecting the correct gaging equipment for accurately determining size differences in millionths or ten-thousandths of an inch, gage specifications must be accurately determined. Unfortunately, sensitivity, magnification, resolution, and repeatability cannot be clearly defined as individual characteristics.

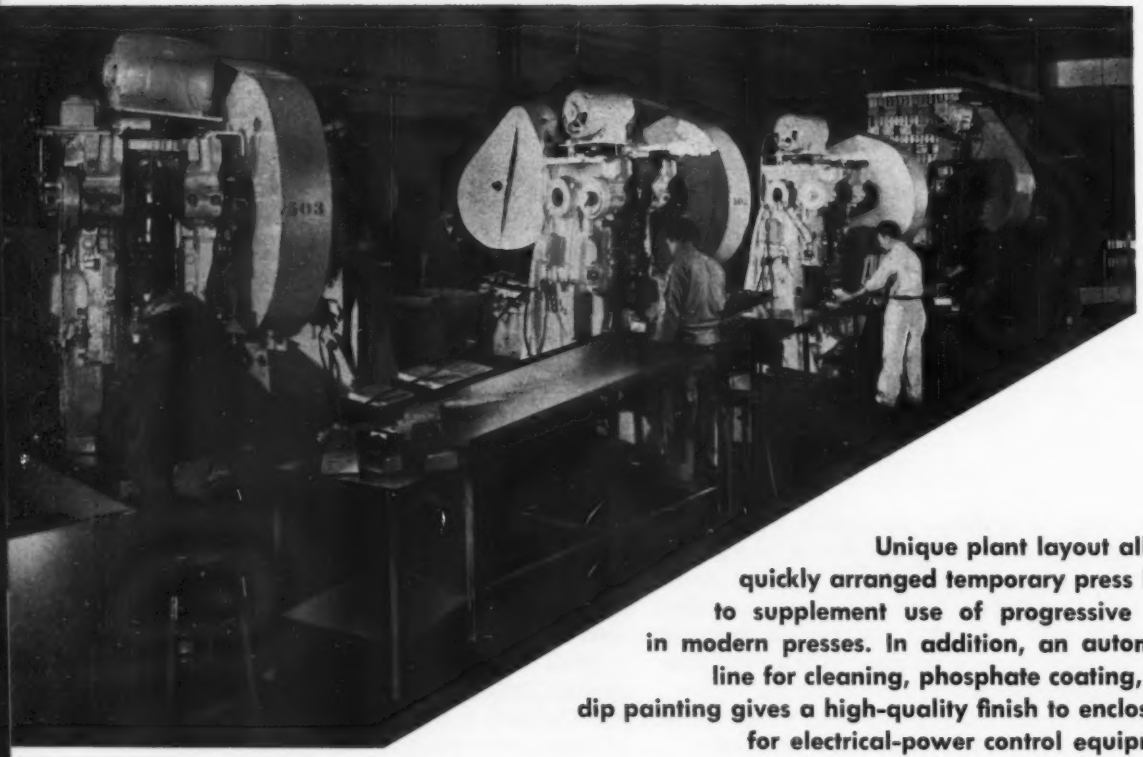
Gage sensitivity might be thought of in terms of the least size change in input that will produce a discernable change in output. On the other hand, the magnification of an instrument is its ability to reproduce small units of size change in terms of larger units or graduations. Sensitivity and magnification are closely related. Regardless of the graduations on a measuring instrument, precision tolerances in millionths require a corresponding degree of sensitivity.

To further complicate the problem, a measuring instrument must be able to duplicate the measurement every time. Gage repeatability is the mark of how close an instrument indicates successive measurements of the same dimension. The repeat accuracy of a linear measuring instrument should be a relatively small percentage of the value of the smallest graduation. And it should never be greater than 10 per cent of the part tolerance.

Most people like to estimate. As soon as a gage reading falls between the scale or dial divisions the tendency is to approximate. Lazily, some try to make a thousandths indicator do the job when one reading in ten-thousandths is required. The contest for precision can still be lost by nursing the compulsion to approximate. When entering the 0.0001-inch tolerance field, be equipped with gages that satisfy all requirements for accuracy—gages that have adequate sensitivity, magnification, resolution, and repeat characteristics to do the job.

"Instant" Press Lines

Machines shifted to suit jobs



Unique plant layout allows quickly arranged temporary press lines to supplement use of progressive dies in modern presses. In addition, an automatic line for cleaning, phosphate coating, and dip painting gives a high-quality finish to enclosures for electrical-power control equipment

HAROLD W. BREDIN, Associate Editor

WHILE engaged in a progressive expansion program in a highly competitive industry, the Federal Pacific Electric Co., Newark, N. J., has resolved many challenging problems. During less than two decades the yearly output of electrical-power distribution and control equipment of this firm has grown from 1.5 to over 100 million dollars in value. Successful operation under these conditions necessarily requires efficient use of manufacturing facilities. This has often been accomplished through early adoption of modern equipment and the development of unusual production practices.

Enclosures are an important requirement for switches, fuses, circuit-breakers and other electrical control equipment. These sheet-metal workpieces have as many as thirty press operations and are made by the company on the basis of a monthly production schedule. Quantities vary greatly and are determined largely by warehouse inventories and data from sales forecasting.

When required in sufficient number, enclosure parts are made in progressive-die setups in large heavy-duty presses. In Fig. 1, a 1000-ton Verson eccentric type, straight-side press is seen stamping covers for Stab-lok circuit-breaker enclosures from 16-gage coil stock. The stock is fed from a mechanically driven slide-feed that is arranged to operate in conjunction with a stock oiler and an automatic coil cradle.

Wherever possible, similar style enclosures are designed for various applications. Many designs are standardized, in part, so that their combined total production will warrant the expense of making a progressive die for at least a number of primary operations. Different secondary operations are then performed on each type in single-die setups.

Not all enclosures, however, are made in sufficient quantity to permit economical use of progressive dies; nor are such dies warranted for equipment for which sales forecasting shows that the demand is slackening or that it is temporary in nature.

In cases where progressive dies are not feasible but production is relatively high and multiple operations are required, the company has developed an "instant" press-line technique (heading illustration). These press lines are formed by actually rearranging presses according to the operations to be done on a part. This has been made feasible by incorporating several unique features in the physical layout of plant facilities.

The press department making sheet-metal enclosures is equipped with fifty-two presses, the majority of which are in the 45- to 100-ton capacity range. These can readily be moved from position to position in a matter of minutes by overhead cranes that serve the area. In Fig. 2, an overhead crane is seen in the process of moving one of these presses to a new location. For this reason the presses are generally not lagged down.

Air and electric-power connections are available throughout the department at each press position. This has been accomplished by installing a plug-in type bus duct (a product of the company) and an air supply along each line of presses. These utilities are either supported overhead (Fig. 2) or run through an underfloor trench system as seen in Fig. 3. In the latter arrangment, cast-iron covers protect each electric-power connection.

For the company, these quick-change temporary press lines represent a necessary step between single-press, single-die operation and the use of progressive dies. They are generally effective when a series of operations are required to be performed in three or four presses and production quantities per run are somewhere between 5000 and 20,000 pieces. When quantities per run reach 15,000 to 20,000 pieces, the advisability of use of a progressive die is investigated.

The basic advantages of the method are improved piecework rates and the alleviation of an acute intermediate storage problem. Material handling is an important consideration at the plant largely because of the volume of production and somewhat bulky nature of the parts. Metal chutes placed between presses in the quick-change lines allow the parts to be passed

Fig. 1. This 1000-ton mechanical press produces sheet-metal enclosures for electrical control equipment in progressive dies.

at die level from machine to machine, thus eliminating unnecessary work handling and inconvenience to the operators.

A team incentive-pay plan which the company has used to advantage is particularly successful for press-line operation. After a setup man has done the first few pieces and has had one fully inspected by the quality-control department, the press line is turned over to an operator team. In addition, hourly inspections are made for size but not location. This is done to determine if the die is sufficiently sharp to continue in use. When a production run is completed, the last part made is compared with the first to ascertain the final condition of the die and the amount of wear.

Tallies of the parts produced by operator teams are taken only after the last operation. The team incentive system reduces bookkeeping and helps keep worker morale high. Often, in press-line work, one operation can be done at a much faster rate than the others. Team members float from press to press to prevent work from piling up at any one press.

The temporary press line seen in the heading illustration is being used to perform four secondary single-die operations on a switch box made from 16-gage cold-rolled steel. Initial operations are performed in a progressive-die setup in a 300-ton Verson press. Coil stock, 8 1/4 inches wide, is fed to the die, which progressively notches four corners; punches eight 1/2-inch diameter knockouts; punches and embosses keyholes and mounting holes; then flattens, cuts off, and forms each part.

For the secondary operations, the first press in the temporary press line (heading illustration) is set up to pierce four 0.265-inch holes and provide two extrusions for 10-32 tapped holes. The die in the second press punches one 1/2- by 3/4- by 1-inch knockout. Cover catch holes and two 9/16-inch diameter holes are pierced in the third press. In the final operation, two hinge slots are provided in the enclosures.

Automated Cleaning, Phosphate-Coating, and Painting Line Produces High-Quality Finish

After the enclosure parts are spot-welded they are processed—along with products from other divisions of the company—on a continuously operating automatic cleaning, phosphate-coating, and painting line of advanced design. Components, such as circuit-breaker panels and cover plates, are first hand-loaded on specially designed hang-

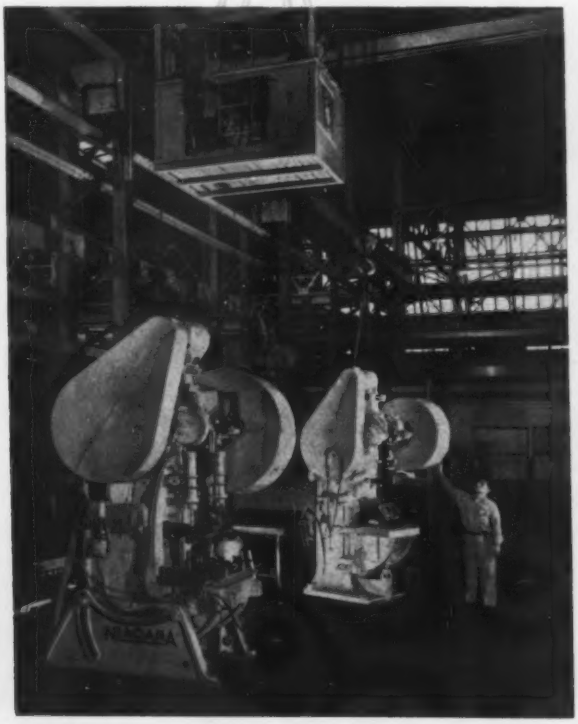


Fig. 2. In setting up the quick-change temporary production lines, the presses are readily shifted from one location to another by means of overhead cranes. This can be accomplished in a matter of minutes.

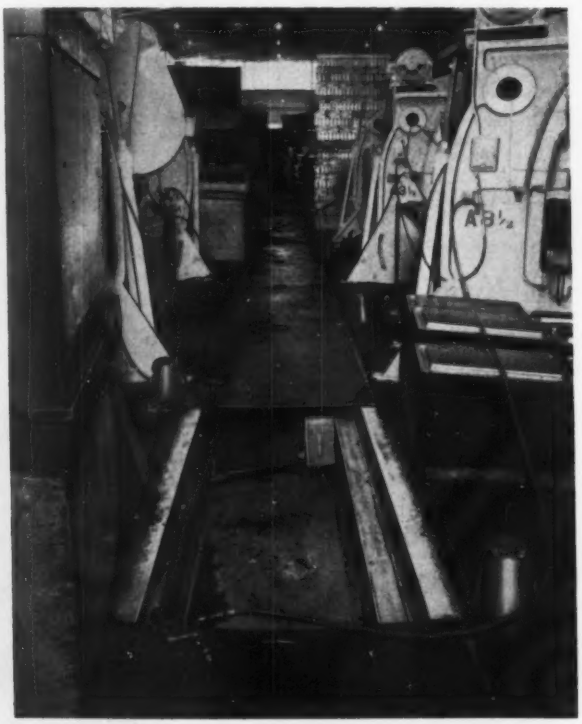


Fig. 3. This underfloor trench system contains compressed air lines and plug-in bus ducts for electrical power supply. Connections are provided at each press location. Cast-iron covers protect electrical outlets.

ers (Fig. 4) in a manner which permits a maximum amount of the paint and other applied fluids to drain off. The hangers are spaced 18 inches apart and travel on an endless conveyor. The parts are brought to the paint line in tote boxes or on skids.

From the loading station, the conveyor enters a five-stage Detrex spray-cleaning machine. The parts first pass through a pressure spray application of a 2 per cent solution of Oakite No. 96 at 160 degrees F. for precleaning and rust prevention. This is followed by a hot-water rinse. In the third stage, a solution of Oakite CrysCoat No. 89, an iron-phosphate coating material, is sprayed on the parts, which then enter a cold-water rinse. Finally, a rinse in a solution of Oakite No. 31 is effected in the fifth stage at 160 degrees F. to improve the corrosion resistance of the phosphate coating and provide better paint adhesion.

On leaving the final stage of the Detrex unit, the conveyor carries the parts through a drying oven operating at 375 degrees F. This is done to remove all moisture from the enclosures before painting. In Fig. 5, the upper portion of the conveyor is carrying parts to the cleaning and phosphating operations while the parts on the lower portion are emerging from the drying oven.

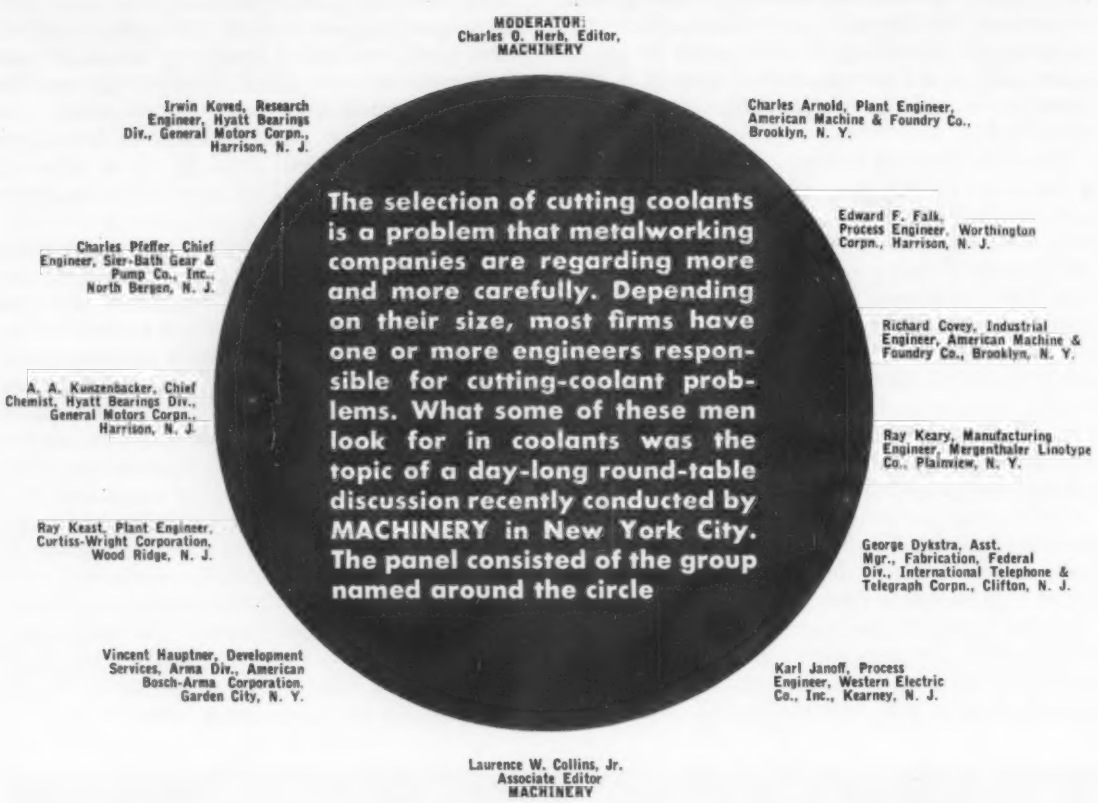
Dip painting is accomplished as the conveyor submerges the parts into a 1500-gallon tank of paint, which is checked hourly by means of samples for viscosity and color. Additives are used to correct color when necessary. A constant color match is important, since enclosure parts painted at widely spaced time intervals must often be assembled into a single unit or placed adjacent to each other.

The paint is kept at a constant temperature, which is also a factor that helps to maintain a matching color on all parts regardless of when they are painted. Baking, the last operation before unloading, is done in an oven at 340 degrees F. The conveyor carries the parts through this oven in about nine minutes. Over-all, the paint line carries the parts about 1000 feet between the loading and unloading stations in about one hour.

All operations are regulated or monitored at a master control console, where changes in operating conditions are recorded and automatically compensated. In case of fire, an emergency control button is pushed to disconnect the power and a valve is opened that empties the paint tank into a special outdoor underground storage tank. A CO_2 foam blanket is applied automatically to the entire area when the temperature rises.

Fig. 4. Here, circuit-breaker panels and cover plates are being loaded on the paint-line conveyor. Specially designed hangers permit maximum drain-off of the paint and other liquids applied to the parts.

Fig. 5. Panel boards on top section of conveyor are moving from loading dock toward precleaning stage. On the lower section, phosphate-coated parts are emerging from the drying ovens on way to dip-painting tank.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The selection of cutting coolants is a problem that metalworking companies are regarding more and more carefully. Depending on their size, most firms have one or more engineers responsible for cutting-coolant problems. What some of these men look for in coolants was the topic of a day-long round-table discussion recently conducted by MACHINERY in New York City. The panel consisted of the group named around the circle
Edward F. Falk, Process Engineer, Worthington Corpn., Harrison, N. J.
Charles Pfeffer, Chief Engineer, Sier-Bath Gear & Pump Co., Inc., North Bergen, N. J.
Richard Covey, Industrial Engineer, American Machine & Foundry Co., Brooklyn, N. Y.
A. A. Kunzenbacker, Chief Chemist, Hyatt Bearings Div., General Motors Corpn., Harrison, N. J.
Ray Keary, Manufacturing Engineer, Mergenthaler Linotype Co., Plainview, N. Y.
Ray Keast, Plant Engineer, Curtiss-Wright Corporation, Wood Ridge, N. J.
George Dykstra, Asst. Mgr., Fabrication, Federal Div., International Telephone & Telegraph Corpn., Clifton, N. J.
Vincent Hauptner, Development Services, Arma Div., American Bosch-Arma Corporation, Garden City, N. Y.
Karl Janoff, Process Engineer, Western Electric Co., Inc., Kearney, N. J.
Laurence W. Collins, Jr.
Associate Editor
MACHINERY

What users would like in Cutting Coolants

THE panel members, a cross section of practical operating men from the New York metropolitan area, were unanimous in agreement that there is no all-purpose coolant in either the oil or the water-emulsion types yet available, although there are a number of coolants for which such qualities are claimed. Close, unremitting control of coolants is still the best method of achieving maximum success in machining operations. With close control must be coupled a willingness to give comprehensive evaluation tests to newly developed coolants. Thus fair opportunities can be offered for new coolants to prove themselves on an equal footing with established coolants.

Those attending the meeting represented a widely divergent group of companies, few of whose products were the same. However, there was unanimity of opinion regarding the practical approach to the selection of water-emulsion coolants for turning and grinding operations. Consideration of the subject was based on the following eleven criteria:

1. Basic chemistry (acceptability to the machine operator);
2. Lubricity (as it affects tool life);
3. Heat conductivity;
4. Stability of emulsion
   (a) tendency of emulsion to separate
   (b) tendency to break down chemically (become rancid);
5. Cleanliness;
6. Possible side effects on machine
   (a) tendency to gum
   (b) effect on hydraulic oil
   (c) effect on aluminum components
   (d) effect on gages;

7. Ability to precipitate solids;
8. Ability to be cleaned from work
   (a) tendency to turn to gum if not removed immediately
   (b) tendency to react with trichloroethylene or other solvents;
9. Qualities as rust preventative
   (a) for the machine
   (b) for the work;
10. Finding optimum dilution ratio;
11. Quality of service from vendor.

The conferees agreed that the industry as a whole, and their individual plants, would prefer one practical coolant that would work for all applications. Lacking a coolant that is ideal for all jobs, users strive to concentrate on the smallest number of necessary coolants that must be kept in inventory, kept separate from each other, and controlled in use. The object is simplification of cutting-coolant problems.

Most of those attending the meeting stated that the problem of "dermatitics" can be reduced by operator education campaigns, improved control of coolant systems, and possible changes in the chemical content of the coolants themselves.

From the practical standpoint, most companies follow vendor instructions on concentration for soluble oils when starting to use a new product. Later on, however, users often experiment by varying solution ratios, making them richer or leaner, in an effort to improve work finish and tool life, to reduce corrosion or staining, and to increase machine productivity.

That available oils have shown improved efficiency and versatility was agreed on by the group. However, accelerated chip loads, faster cutting feeds and speeds, and the introduction of special new metals have made it necessary for user companies to have a wider variety of cutting coolants on hand to satisfy special conditions. For example, certain types of stainless steel require unusual, often hard-to-get cutting oils. Titanium, aluminum, and magnesium are examples of other materials requiring special attention.

From another aspect, high-speed turning with carbides has introduced a separate set of factors. Still other requirements, such as ultrafine surface finishes demanded on missile "hardware," can also affect the use and selection of soluble oils and other cutting coolants.

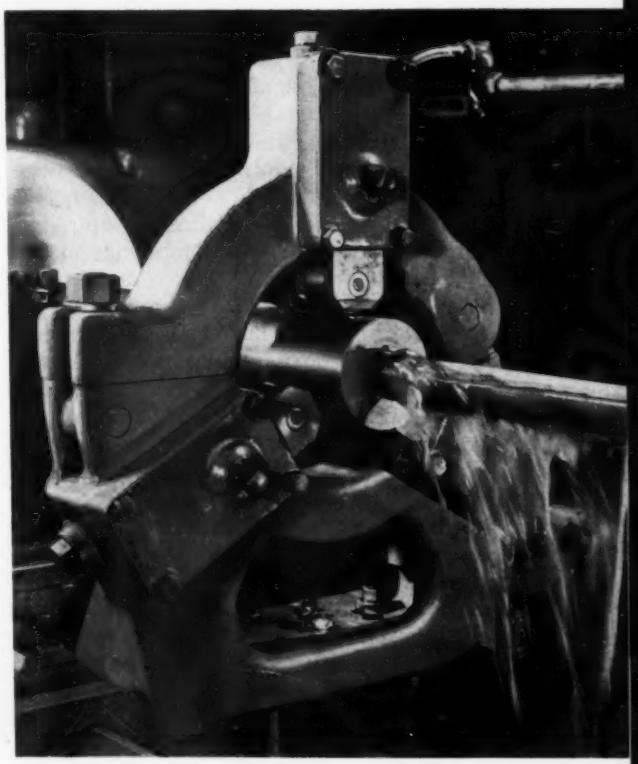
Managements have increasing confidence in the personnel entrusted with the selection and control of cutting coolants. Several panelists recalled incidents where they had been ordered to replace a satisfactory coolant with one claimed to be a panacea for certain problems, one possessing miraculous properties, or perhaps one cheaper in price. Such coolants were given a fair trial, but in a high percentage of cases they were found to have shortcomings in one respect or another. The management was usually glad to return to the original coolant. However, in a few instances the new coolants did prove better.

Coolant identification is often a front-line problem. For example, two coolants may have somewhat similar chemical and physical qualities. However, the coolants may be of different colors or have distinctive odors. Operators may erroneously associate the color or odor psychologically with good or bad results and request or refuse a particular coolant. Thus, the cooperation of the machine operator is often a factor of the highest importance in coolant specification. In some instances, operator education is actively fostered. The panel agreed that tests can be strongly influenced by operator preferences. All panelists agreed that the service men of supplier companies can be most helpful in solving unusual problems.

Comments made by various panelists on different phases of the general subject will be given in the following.

General-Purpose Cutting Coolant

Ray Keast, Curtiss-Wright Corporation: I do not think the general-purpose cutting oil exists, although all manufacturing coolant specialists are



looking for a "dream" soluble oil that will do everything. At our plant we have evaluated the many types of cutting coolants on the market today. We started evaluating emulsified mineral oils years ago. These oils turned rancid quickly. Then the oil suppliers started improving their coolants by putting in additives, including germicides. By this time semisynthetic oils were introduced, filling a notable gap.

At the present time completely synthetic oils are available. These do not appear to be as flexible or versatile and don't have as much lubricity as Curtiss-Wright's particular jobs sometimes require, but they are excellent at extremely high speeds. Unfortunately some of these oils are good "paint removers" and are limited when it comes to interrupted cuts. The result is that Curtiss-Wright has returned to semisynthetic soluble oils because they have the lubricity and heat-absorption qualities our jobs require. The coolant has to be versatile because we have a piped central system and the same emulsion has to be used for grinding, turning, and other cutting operations.

The Rancidity Problem

A. A. Kunzenbacker, Hyatt Bearings Division, General Motors Corporation: Acidity, source of rancidity develops from one or both of two sources. At Hyatt we find that rancidity and consequent odors develop when lubricating or hydraulic oil accidentally gets into a coolant sump and covers the surface. Oils float on the surface, sealing out the air. Certain anaerobic bacteria flourish in the sealed emulsion and they are the source of odors and rancidity.

Bacteria flourish only in the absence of air, and are nourished by the sulphur compounds in the emulsion. Thus, the first requisite is an air supply to the reservoir. It is even a good idea to bubble air through any tank serving machines prone to leak hydraulic or lubricating oil to aerate and agitate the emulsion.

Therefore, we avoid oil films which may insulate our soluble oil sumps. This practice has delayed the onset of rancidity to the point where, in the practical operation of our system, the solution virtually never becomes rancid in the usual sense of the word.

Another cure for rancidity is the control of acidity. Soluble oils have a measurable alkalinity at which they perform best. Whether the solution is acid or alkaline is easy to determine with litmus paper or a pH meter. The bacteria causing the odor that denotes rancidity multiply in an acid solution much more rapidly than in an alkaline tank. Even though a coolant reservoir may be sealed from the air with a film of oil, rancidity is delayed when the solution is properly alkaline because the bacteria do not flourish, even in the warmest summer weather. Skin infections are fewer.

Alkalinity must be maintained under a regular system of controls. The as-mixed or normal alkaline pH can be maintained by additions of soda. At Hyatt one of the chemistry laboratory technicians tests the pH of the solution daily by holding a pocket meter in the inflow of the tank. The pH meter is a gadget about as big as a pencil. It is carried in the pocket. A pH reading takes about five seconds. If the alkalinity of the solution needs correction, the laboratory works out the number of pounds or bags of soda required and sends an order to the maintenance department. This is inexpensive. For example, a $4 bag of soda will alkalize a large system for a week or more.

Control Problems

Ray Keast: We have to have coolant solutions that do not require constant changing and cleanout of reservoirs and sumps. Maintenance labor is so costly that no company can afford a big force of men devoted entirely to this work. Therefore, we need stability, reliability, and versatility in expendables like coolants. The company has a special process-engineering group which analyzes the causes of problems that seem to flare up from time to time. During the course of its work this group often finds that when a tank has gone rancid, or the tools suddenly begin to wear out unusually fast, there are contributing factors that must be analyzed quickly. Not infrequently it turns out that some budding specialist wants to show that he took some chemistry courses. He thinks he knows "just the thing" to add to the coolant tanks, and as a consequence we have found strange things in coolants and cutting oils. To control such geniuses is difficult, but it is part of the game.

Proof-Testing New Coolants

Ray Keast: The first step in selecting a new coolant is to clear the soluble oil through our medical department, because we cannot have any unsafe materials in the shop. Next we test the oil in our pilot laboratory for miscibility (capability of being mixed with water). Also we test it for its resistance to rancidity and its shelf life in different parts of the plant. We also send a sample to our chemistry laboratory for appraisal of chemical characteristics.

If the coolant comes through these examinations we put it on a machinability test in our pilot

laboratory. There it goes to work in our Monarch testing lathe for analysis of its heat conductivity and its ability to extend tool life. Finally, a promising cutting coolant goes out to the plant, where we give it a test on an actual production basis.

Soluble-Oil Stores Control

George Dykstra, Federal Division, International Telephone & Telegraph Corporation: My plant uses four different types of soluble oil. We are always facing problems created by the machine operator going to the storage area drum and adding the wrong oil to his reservoir. Naturally, the two types of soluble oil are not designed to be mixed. The result is often a gummy mess and poor performance.

Ray Keast: At Curtiss-Wright each machine has a cellophane envelope with a big numeral on it. The number is the code for the coolant used on the individual machine. The supply drum has a corresponding number. This is our attempt to keep the coolant on its proper job. The only time we allow any change in oil is when a machine is being started up with a new job that takes a different coolant. By then, of course, the code numeral will also change to the new designation. We discourage the use of "miracle" additives that salesmen are continually bringing in for us to test. A little additive testing is a good thing, but one has to be practical. The additives could easily be put in the wrong machine, if we decided to use them. But more than this, if we were to run tests with all the different oils that people want us to try, we would be doing nothing else but testing.

We have confidence that our vendor of coolants is resourceful and has already put in the additives that these self-styled magicians claim are so wonderful. We have been through some extremely expensive and unpleasant experiences with various additives that we tested because they would not mix. Some gummed the work and machines badly. Others seemed to have a reverse effect on the basic soluble oil. Thus it is that we are now very conservative in accepting the stories of "cure-all" additives from salesmen.

Synthetic Soluble-Oil Film-Removal Problem

Edward F. Falk, Worthington Corporation: We had a particularly difficult time removing the residue left by a synthetic chemical-base soluble oil which made a tinted solution. This is called a multiplying oil. We tried to remove the film in a vapor degreaser with an ultrasonic cleaning station. The residues did not come off, but seemed to crystalize and harden on the work-surface like salt. We ended up having to give everything an alkaline wash before vapor degreasing or else scrub by hand. But we had to vapor degrease later on to satisfy the job specifications. We then changed to a petroleum-based material.

The chemical synthetic oil made a clear solution rather than a milky one. It acted like a detergent. It removed from the machine the residual gum left over from the preceding coolant. So much gum came off that we had to dump the tank and clean it to get rid of the mess. Then we mixed a new solution. The new coolant started to deposit its own gum in place of the original film. Furthermore, it attacked some aluminum parts and left a dry film of its own on the work. It caused dial indicators to stick. The film could not be seen until after a trip through the trichloroethylene vapor degreaser. When the heat got through baking the film it looked like salt. It was very sticky and had to be scrubbed off manually. Petroleum-based emulsion coolants were, for us, the only really satisfactory selections to overcome the foregoing difficulties.

Analysis of Testing Results

A. A. Kunzenbacker: Our laboratory makes an analysis which could be classed as a rough screening to reject soluble oils that are objectionable for obvious reasons, such as bad odor, corrosiveness or toxicity to the skin. But the laboratory will only rate an oil on a probability basis. The chemists will seldom give a flat acceptance or refusal. We skip the intermediate test with the laboratory lathe mentioned by Mr. Keast because our machine tools are all multiple-spindle units and hence it is impossible to evaluate performance.

We put the candidate soluble oil right into a production machine, but with a separate coolant supply. Alongside this test run is an identical machine using the standard coolant on the same job with the same operator. We run the candidate and the standard central system soluble oil side by side for two or three months. The laboratory maintains these machines to make sure there is no partiality. Also, the laboratory keeps records on tool life, production, down time, and coolant-oil consumption over a long enough time to point up the performance trends, if any. Operator and supervisor opinion is asked regarding the quality of the solution. By this method of checking performance we can give a good appraisal of the merits of the oil. Often, though, a second major test, in which all the machines in a department may participate, may be run off before the soluble oil is accepted for replacement of the existing coolant.

HIGH-RELIABILITY MISSILE COMPONENTS

. . . made in short runs by novel tooling

Short runs, miniaturization, and unusual quality requirements bring a different way of life to the machinist working on missile-control gear trains. Ingenuity combines with design simplicity in boosting productivity and cutting down floor-to-floor time in the most exacting work

LAURENCE W. COLLINS, Jr., Associate Editor

Fig. 1. No backlash in assembly and high center-to-center accuracy are required in this Arma Division computer gear-box.

"POOR-MAN'S TAPE CONTROL" is the name applied by Arma Division workers to a positioning attachment used on Pratt & Whitney jig borers. This device locates shaft bores in ultraprecise gear-box frames for missile ground operational equipment. The technique and equipment were developed by manufacturing operatives of Arma Division, American Bosch-Arma Corporation, Garden City, N. Y., in order to reduce the time usually required to finish-machine the holes carrying an ultraprecise fine-pitch gear train, Fig. 1, that is part of the electromechanical system. The positive locating fixture for the jig borer eliminates the need of repositioning the machine table for each hole, a time-consuming operation, often involving computation and the possibility of error. Center-to-center tolerance of the holes is 0.0002 inch.

The table of the jig borer is centered under the spindle and locked in this position. Then an auxiliary baseplate is mounted into the table T-slots as in Fig. 2. Spacers under the plate provide operating space for a plunger moving vertically through a bushing in the center of the auxiliary table. The top of the plate is ground to surface-plate flatness and smoothness. The plunger can be raised so that its precisely ground outside head diameter projects above the surface of the plate.

The work may be either the cast-aluminum gear-box frame or its mating cover. The drilled blank is located by a dowel-pin and bolted to a master mounting plate. The bottom of this plate has a hole corresponding to the center of each hole to be bored in the work, Fig. 3. The size of the holes is a close fit with the head of the spring-loaded plunger. As one hole is completed, the plunger is pulled down, freeing the mounting plate. The operator then can move the plate, with the work, to the next hole, Fig. 4. He releases the

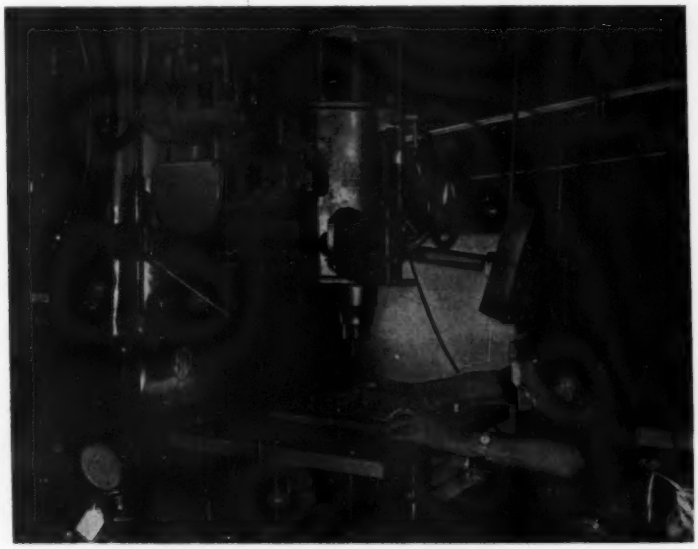


Fig. 2. Auxiliary baseplate is spaced above the jig-borer table to allow clearance for plunger. Table is never moved during boring of a case or cover plate.

plunger, which rises into the locating hole, giving the next positive location.

The holes in the mounting plate are not bushed. It is made of Pioneer DC921T aluminum alloy, hardened and stabilized by direct chilling. The thirty-six holes in the master plate are all located and bored on a special Swiss jig borer to achieve the highest layout accuracy. The tool-steel plunger has the appearance of a plug gage with a second smaller step at the head. The large diameter mates with the bushing in the auxiliary support plate, and the small diameter step-fits the holes in the mounting plate. Both diameters are hardened and ground to a tolerance of 0.0001 inch.

Using standard jig-boring techniques, the boring of the holes in one frame would normally require three full days. The fixturing system called poor man's tape control reduces this time to only six hours. Five different sizes of holes are bored simply by changing preset boring cutters through the use of quick-change adapter.

Problem: Fine-Pitch Gears

The fine-pitch spur gears used in these instrument gear-boxes, Fig. 1, are another example of highly accurate parts made in short runs by novel tooling. All parts made by Arma Division must be interchangeable with those made by subcontractors. A major effort by the company was necessary because it was not able to find equipment capable of producing gears to the required accuracy, with consistency, on a production basis. However, special blank-holders and special maintenance permitted domestic hobbers to meet specifications. The gears have presented an inspection problem in that they exceed in accuracy any master gears the company has been able to obtain from domestic or foreign sources.

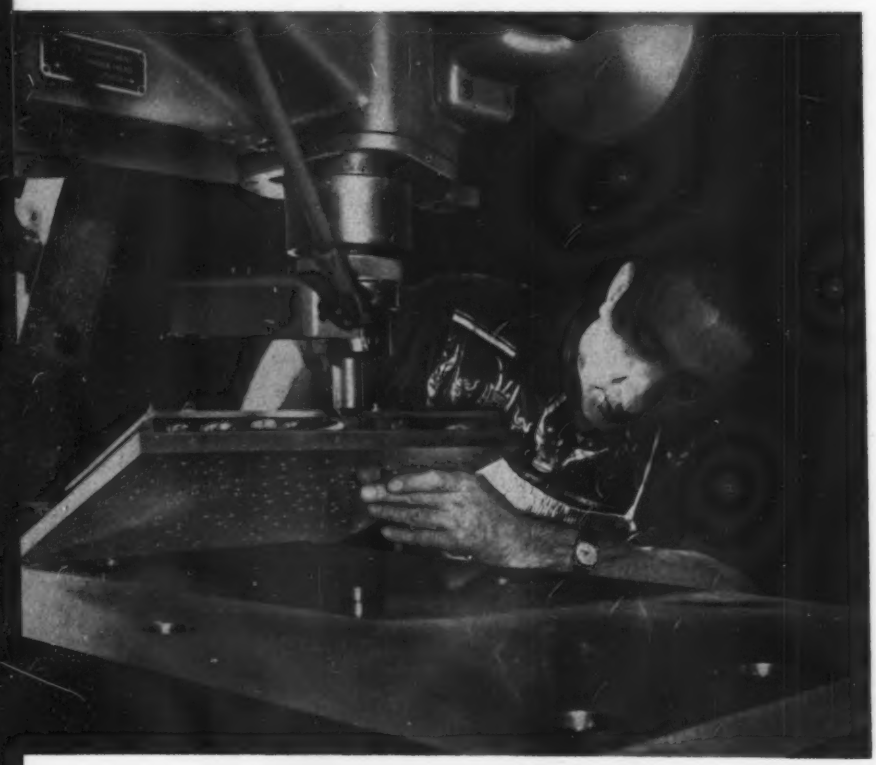


Fig. 3. Holes in fixture plate are picked up by the ground plunger protruding through the auxiliary plate to position the gear-box cover.

A typical spur gear in this category is of aluminum, 64-pitch, 100-tooth, 14 1/2-degree angle, and has a pitch diameter of 1.562 inches. The hobbers are standard No. 3 Barber-Colman machines for which special work-holding arbors have been designed and built by Arma Division, Fig. 5. As-hobbed accuracy is consistent enough to obviate shaving of the gears. Inspection by a Red Line checker shows composite error consistently below 0.0002 inch.

The procedure for making gears of this accuracy starts by achieving extreme accuracy in making the gear blanks. For example, the slotted hubs of the gears are bored to an accuracy of plus 0.0002, minus 0.0000 inch, in a double-headed Heald Borematic. The traditional hobbing method, and that used by Arma until the imposition of reliability standards, was to use tapered arbors. The old method, with shaving, would occasionally give the accuracy required, but did not yield repeatable results that would guarantee interchangeability with gears made by subcontractors.

Arbor Components Universal

The special arbors are interchangeable on all the company's No. 3 hobbers and are made of hardened and ground tool steel. The adapter mounts to the hobber spindle as in Fig. 6, and is trued at the inside diameter so that it will run absolutely concentric. Necessarily, the hobbing machine must be maintained with zero spindle runout, which means frequent rigid inspection of bearings and no backlash in gearing. The assembly of the work-holder is shown "exploded" in Fig. 7. On the left is the adapter plate *A*, which is bolted to the hobber spindle. The back-up collar *B* slips over the adapter shank, which accepts the arbor and its holder *C*. The arbor shank (it has ground threads) accepts the blank bore *D* in

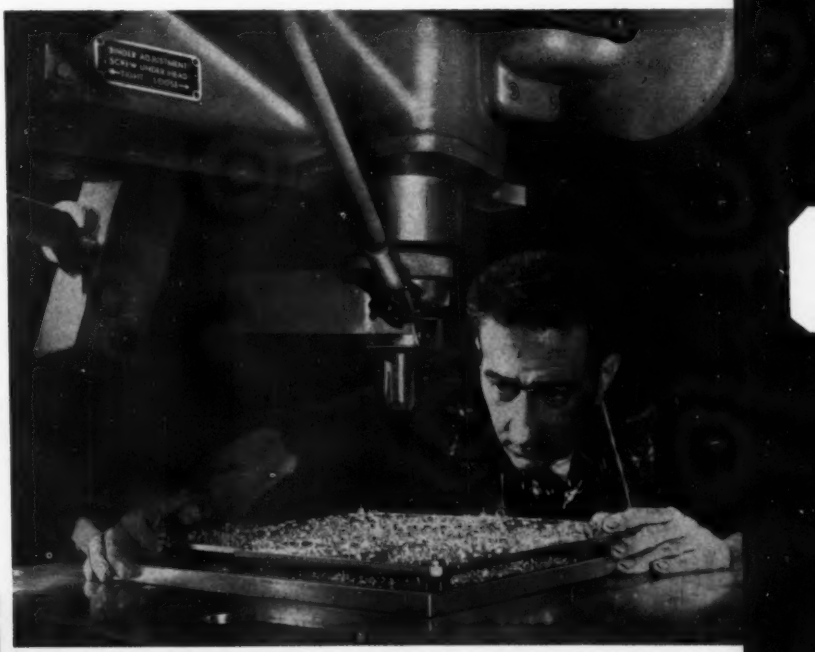


Fig. 4. Poor-man's tape control of positioning gear-box cover permits thirty-six holes to be bored to 0.0002-inch center-to-center tolerance in six hours.

Fig. 5. Class 3 AGMA gear accuracy in fine-pitch gear hobbing is achieved without shaving by home-built blank-holder.

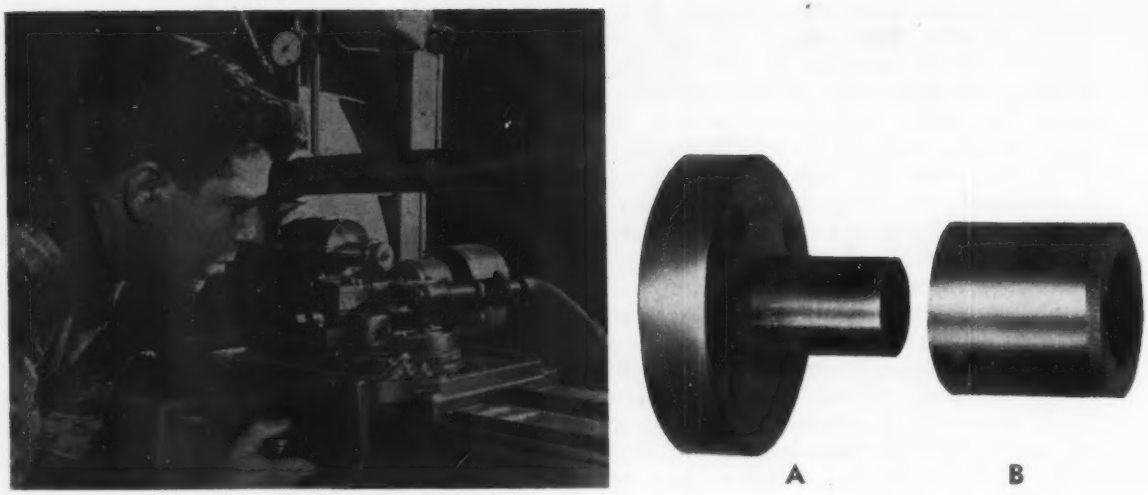


Fig. 6. Using high-precision blank fixture, a standard Barber-Colman hobbing machine makes computer gears at low cost for short runs typical of air vehicles.

a push fit without taper. Holding collar *E* clamps the work-piece against the face of the back-up collar for rigid support. Pressure is exerted by bolt *F* on washer *G*. Most of these elements are interchangeable. A typical hob is illustrated at *H*, and an extra arbor at *I*.

Tool Maintenance

No effort is made to establish world records for cutting the greatest number of spur gears without sharpening the hob. Hobs are replaced well in advance of their becoming slightly dull because Arma has found that dull tools are nonproductive. The hob is high-speed steel and is a standard tool. Cutting speed of the hob is about 200 sfpm.

For a number of years the company has obtained spectacular production speeds and efficiency on short runs through its use of pantograph engraving machines. Because of its resourcefulness in handling a great variety of "odd-ball" profiling jobs, the engraving department has increased in size and influence. Where it once made only nameplates and identification tags, it now successfully handles practically "all the jobs nobody else wants to tackle." A recent acquisition is a George Gorton three-dimensional Pantomill, a pantograph engraving machine whose inception was sparked by the success Arma and similar manufacturers achieved in using the simple, two-dimensional name-tag engraver as a machine tool.

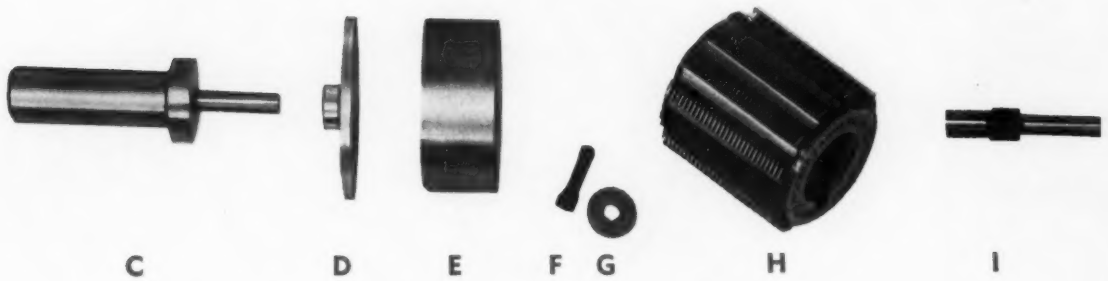
The company added many ingenious small refinements of its own in equipment and methods until the department reached an unusually high status. Cutter spindles were rebuilt to high accuracy so that difficult, nonsymmetrical profiles could be cut. A technique of rapidly making accurate templates of large size was developed, so that minor errors, reduced by the pantograph, were minimized.

Engraver Becomes a Machine Tool

With the advent of the new Gorton P2-3 pantograph engraver, Figs. 8 and 9, the department can now handle a wider variety of work than with the older machines, getting even better results and in less time. For example, the new machines have a spindle lead-screw that the older machines did not have. They are heavier all over and more accurate, but at the same time, faster to use. The three-dimensional pantograph engraver is a full-fledged machine tool.

An example of the short-run work done with the pantograph profiler is the spider for a gyro rotor. This is the wheel-like cast-aluminum part that is shown, after profiling, at the extreme left of Fig. 8. In the same illustration, just to the right of the spider, is the pantograph template being traced by the cutter in the blank at the right. The spider is cast with a steel bushing for the hub. It is a high-speed rotating part requiring critical balance and is, therefore, machined from the solid, Fig. 9. The design resembles a spoked wheel. However, the spokes are not cut all the

Fig. 7. Build-up of special gear-blank holder is from components (A), adapter; (B) back-up; (C), arbor and shank; (D), blank; (E), holding collar; (F), holding screw; (G), washer; (H), hob; and (I), spare arbor.



way through but have a stepped section. The pantograph profiler on each side forms pockets having a somewhat triangular shape, bottoming on a web. The machining also cleans up areas within the hub bore, all to a depth tolerance within 0.002 inch at the web.

The purpose of cutting the pockets in the spiders is to reduce weight and give stability to the finished product. Some idea of the critical nature of the dimensions can be gained from realization that the diameter and other geometry of the hub hole bushing must check out to a tolerance of ± 0.0001. Profiling of pockets starts downward at 0.015-inch tool feed per pass, using the outer path in the template, Fig. 8. After the step depth is reached, the operator changes to the inside groove of the template and cuts all the way to web depth. Profiling the pockets of a spider with a pantograph consumes only about one-sixth of the time of the next fastest method.

Fig. 8. Stylus in operator's right hand follows pattern in template to sink stepped pockets in aluminum spider blank for a critical gyro rotor.

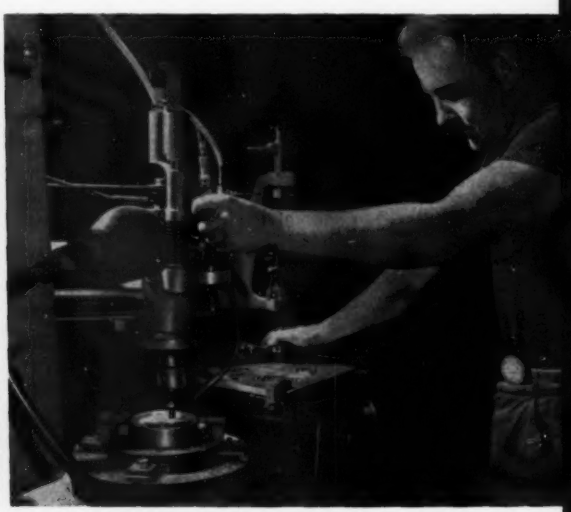


Fig. 9. Gyroscope spider is profiled from the solid on new Gorton Pantomill Model P2-3 engraver for profile-milling in three planes.

2 dies

M. J. GOLDSTEIN

TWO types of dies seem to have been neglected as a means of cutting costs in the production of metal stampings. One is a pinch-trim die, the other a swaging type die. The latter is especially useful on thin metal parts. The pinch-trim principle, which is easily employed with combination dies, saves an operation, and with present labor costs, the savings can be considerable for long-run jobs.

A shell produced with tooling that incorporates both these features is shown at Z in Fig. 1. A pinch-trim operation was used in the initial combination die, and a swaging die finished the shell. The part was designed for use as a jar cover.

The die for the first operation (Fig. 2) produced the drawn, trimmed, and perforated shell illustrated at X, Fig. 1. This shell, made of 24-gage (0.020-inch) steel, has a blank size of 3 3/4 inches. As can be readily seen, the die has the usual construction of cut-and-draw dies, but the plug over which the metal is drawn is formed of two members, *A* and *B*. The die-body is oil-hardening steel ground all over. Part *B* has the shape required for the shell and also contains a bushing *C* for punching a 3/16-inch diameter hole in the top of the stamping. The recess in part *A* is made 1/16 inch deeper than the shoulder on part *B* in order to allow for regrinding of the pinch-trimming surface of part *A*.

The pinch-trim edges on the lower and upper die members are designated by *D*. Bushing *E* is faced-off the same amount that is ground off the cutting face so that the bushing will always be in contact with the bottom of part *B*. This bushing insures that scrap from the perforating operation does not enter and clog the space pro-

...that cut stamping costs

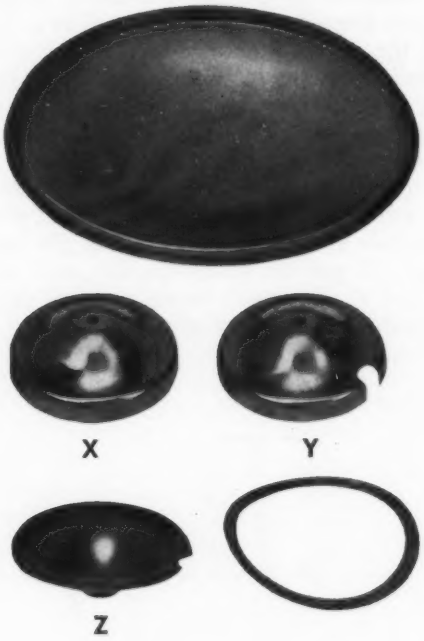


Fig. 1. (Left) Steps in the production of two similar type stampings, featuring the use of economical pinch-trimming and swaging dies. Trim from first-operation part (X) is seen at right of part (Z).

vided to allow for regrinding of the cutting edge of member *A*.

The die was mounted in a die set and a 1/2-inch hole was bored in the punch-holder for a punch *F*. This member, operating in combination with die bushing *C*, punches the hole for attaching a knob to the cover. Two knockout pins are provided at *G*, and both punch *H* and die *A* were drilled for air vents *J*. Air vents were also provided in the die-shoe, since any air lock would prevent the shell from being stripped from formed member *B*. Pressure-ring *K* is hardened and ground for a close fit on part *A*.

In the second-operation die (Fig. 3) a slot on the corner of the shell is cut to accommodate a spoon. Member *L* was made of machine steel with a tool-steel insert *M* and turned to provide a 1 1/2-inch diameter shank. After rough turning,

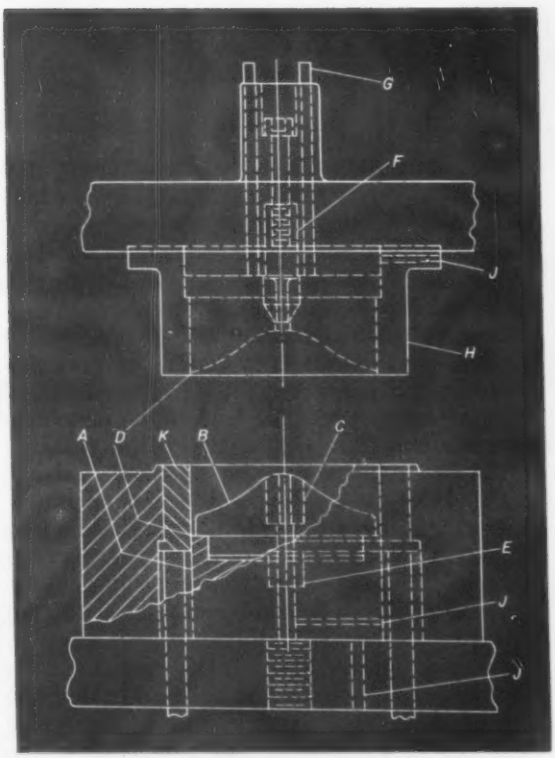


Fig. 2. This combined drawing and pinch-trim die has an oversized recess in member (A) to allow for sharpening of cutting surface (D). A hole is punched in top of the shell in the operation.

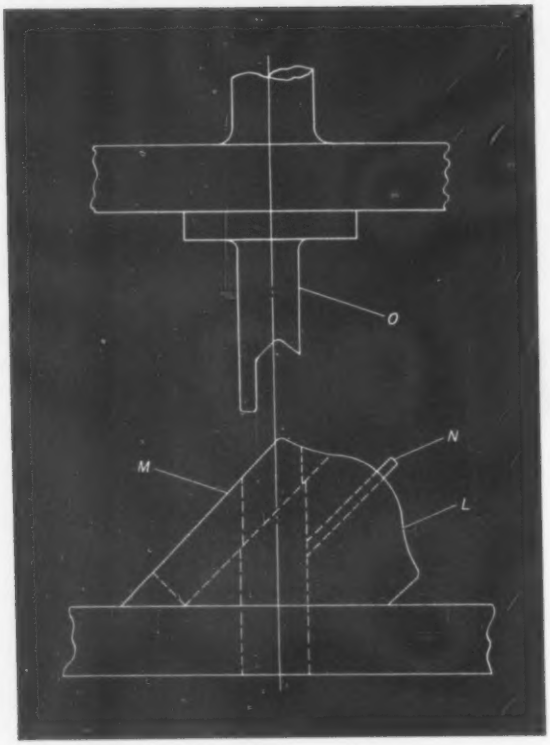


Fig. 3. Die for cutting a slot in the corner of shell (X), Fig. 1. Heel of punch (O) enters the die before cutting starts.

a slot was milled for the tool-steel insert. The member was then finish-machined with the tool-steel insert in place, and a hole was drilled in the center for a pin *N* to fit the hole in the shell. In the final operation the bottom of the die was machined at a 45-degree angle.

Punch *O* was roughed out and mounted on the die set, and then fitted to the die by gradually shearing-in the member while in the press and filing off excess steel. The heel on the punch enters the die before cutting takes place.

The die used for swaging the shell is shown in Fig. 4. No die set was used for this operation, as metal-cutting was not involved. The die ring *P*, made of oil-hardened steel, has a recess *Q* at the upper end equal in diameter to the outside diameter of the shell before swaging. The depth of this recess is equal to the length of the shoulder required on the shell—in this case, 1/8 inch. The smaller diameter of the ring (and the diameter of the center forming plug *R*, neglecting clearance) is equal to the inside diameter of the shell. A pin *S* is provided in the plug for setting purposes. The air-vent hole *T* in the punch *U* is 3/16 inch in diameter and was put in the punch at the time the shaped recess was machined.

Four pressure pins *V* were provided and a 5/8-inch thread was cut in the base for a rod to hold a rubber spring barrel. An air hole *T* was also provided in the bottom ring to prevent air lock, which would hinder proper operation of the die.

The height of the pressure pins is such that when the shell is placed in position on the plug, the bottom edge of the shell touches the bottom of the recess. When the punch comes down in contact with the shell, the excess metal of the shell then can go only outward, thus forming the required swaged shoulder.

Similar in design were the dies used in making shell ZZ, Fig. 1. This part was for a casserole cover. The blank was 8 1/2 inches in diameter and the material, 24-gage (0.020-inch) brass. Shell *XX* was formed and pinch-trimmed in a die similar to the die for making shell *X*. As in the case of shell *X*, about 1/4 inch is trimmed off by the pinch action. The pressure-ring must be a close fit on the plug over which the metal is drawn. As in any trimming die, the sides of a shell will always spring outward. This enables the pressure-ring to strip the shell, provided that the die has proper air vents. The swaging die for making part ZZ was similar to the die used for finishing shell Z, the punch being made to suit shell *XX* produced in the first operation.

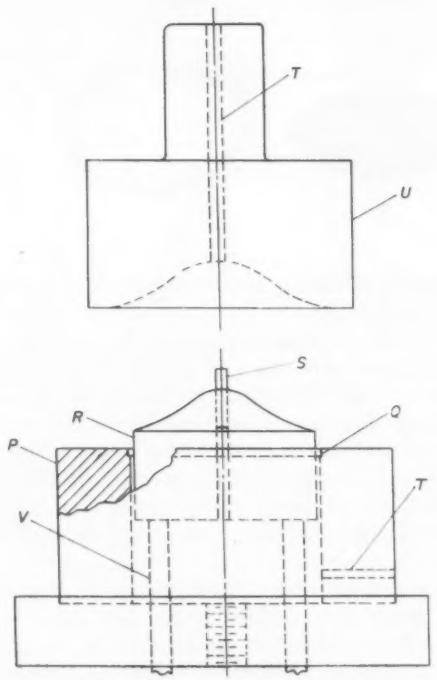
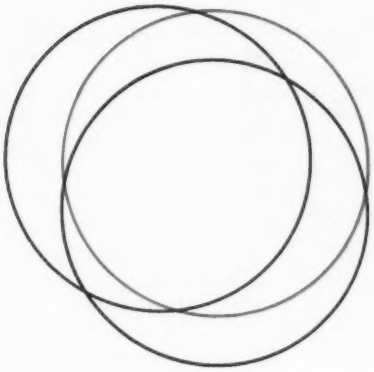


Fig. 4. When punch (U) descends on shell (Y), Fig. 1, the metal in the flange can only go outward, forming the required swaged shoulder of shell (Z).



How roller guidance affects needle-bearing performance

An important feature governing the performance of any needle bearing is the manner in which the rollers are guided. As a consequence, the method employed largely determines how well a bearing will operate in an application. This article dicusses three types of needle bearings and the various aspects of roller skew, load, shaft alignment, and lubrication that must be considered in choosing each design for a particular use.

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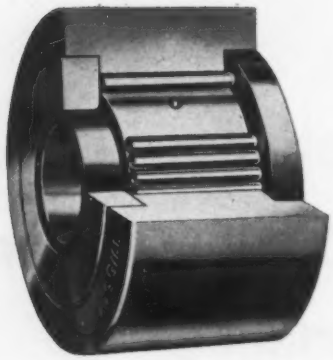
McGill Mfg. Co., Inc.
Valparaiso, Ind.

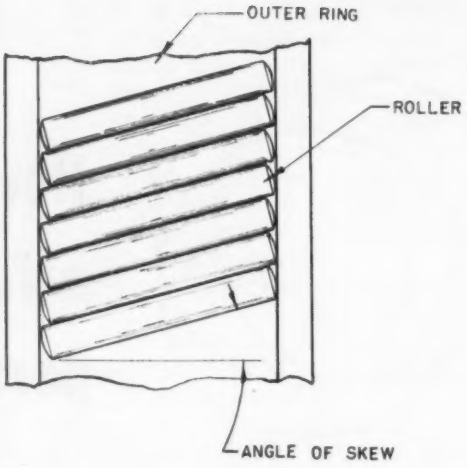
Full-Complement, End-Guided Type

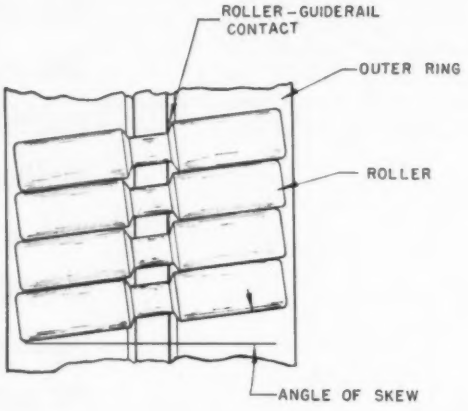
In needle bearings of this category, Fig. 1, roller guidance is obtained by controlling the circumferential and diametral clearance very closely. As little room as possible is allowed in the roller cavity for physical displacement of the rollers from their parallel axis (roller skewing).

A certain amount of wedging between the rollers and races will take place if shaft misalignment or deflection is present in an application. When these conditions are excessive, actual binding of the bearing can occur. Accurate alignment, therefore, is very necessary with the use of this type of bearing.

From a load-carrying standpoint, roller crowning (other than a very slight end relieving) has only a minor effect upon the performance of full-complement bearings. A full crown, or end relief, would tend to increase circumferential clearance between the rollers and thus also increase skewing. This would only aggravate an already somewhat exacting need for shaft alignment. These bearings are best for uses involving slow rotation




OUTER RING
ROLLER
ANGLE OF SKEW


ROLLER – GUIDERAIL CONTACT
OUTER RING
ROLLER
ANGLE OF SKEW

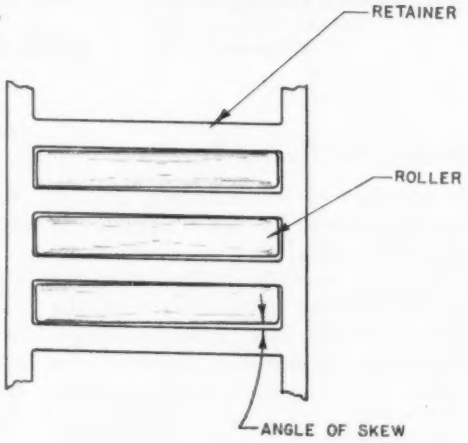

RETAINER
ROLLER
ANGLE OF SKEW

Fig. 1. (Top, opposite page) Cutaway view of a full-complement, end-guided needle bearing, and a sketch showing the relative amount of skew possible.

Fig. 2. (Center) Skewing in a center-guided needle bearing is limited by the roller-neck to guide-rail clearance. Angle of skew is less than that for the bearing type shown in Fig. 1.

Fig. 3. (Bottom Rollers in a retainer type needle bearing are restrained to a very small angle of skew by the clearance in the retainer pocket.

or oscillation where alignment is maintained. Rotative applications should be carefully engineered, with speeds held down to recommended limits and ample lubrication provided.

Center-Guided Type

A modification of the end-guided type, these needle bearings (Fig. 2) do not require close circumferential clearance to secure proper roller guidance. As a result, higher speeds are possible. The principal factors governing roller guidance in this type of bearing are diametral clearance and roller-neck to guide-rail clearance.

In center-guided bearings there is a tendency for the rollers to skew, or shift from a parallel position, when the shaft or inner race is not in alignment. Skewing is limited, however, because the roller is restrained from moving out of position by the guide rail. This helps to prevent internal binding, or roller seizure. A center-guided bearing is better suited to applications where shaft misalignment exists, but the same basic problem of roller corner loading is still present.

Roller crowning has a beneficial effect on performance. Although it is impossible to calculate the amount of skewing for a wide range of applications, crowning, or end relieving, will decrease high stress concentrations due to roller edge loading and provide a corresponding increase in bearing life.

Center-guided bearings can be employed in static, oscillating, or relatively high-speed rotary applications, providing adequate lubrication is used. The theoretical load-carrying capacity is quite high; but to take advantage of this, close alignment must be maintained.

Retainer Type

Since parallelism and alignment of the rollers can be controlled accurately by the clearance in the retainer pocket (Fig. 3), these bearings are provided with the best guidance method. They will withstand greater misalignment of the shaft under normal bearing loads, as roller skewing is not a problem. To obtain better performance, roller crowning, or end relieving, is essential.

Retainer type needle bearings are suitable for all stationary, oscillating, and rotary applications. Due to a more predictable performance, the retainer type has proved suitable for operation at high speeds with limited lubrication, and under heavy loads where an abnormal amount of shaft misalignment and deflection exists. When the advantage of positive roller guidance is combined with that obtained through the use of crowned rollers, performance is further improved. The reduction in internal friction thereby provided also somewhat alleviates the lubrication problem.

There are definite application limits for each variety of bearing, but where a design requires as compact a bearing as possible, one or more of these needle-bearing types can generally be employed. Needle bearings will carry relatively large loads, yet occupy a small radial space.

Pratt & Whitney Launches Machine Tool Trade-In Plan

In what is termed a "first" for the industry, the Pratt & Whitney Co., Inc., West Hartford, Conn., will accept used or surplus machine tools of any manufacturer as part payment, or for credit, toward the purchase of new P&W products. To handle these trade-ins, a new corporate unit of Fairbanks Whitney (P&W's parent company) has been established under the name of the Machinery Trading Corporation. This unit will have all the facilities to properly warehouse, recondition, and sell machines taken in trade. It also will actively engage in the used-machinery field by purchasing surplus machinery for its own stock.

Under this arrangement Pratt & Whitney is not in the used-machinery business, and its personnel are not involved in the sale of this equipment. Although the new company is a separate corporate unit, it will work closely with P&W to provide one-stop service for those considering purchase of new machine tools.

Although approximately 60 per cent of industry's machine tools are more than ten years old, P&W contends that age alone is not the determining factor. It feels that machines no longer suited to the production requirements of one manufacturer might well be a great improvement to the plant of another. By making the accepted trade-ins available through normal used-tool channels, other companies will be helped in upgrading their own production equipment.

Improved Ultrasonic "Detective" Hunts Voids and Inclusions

GAS bubbles and slag particles that once played hide-and-seek beneath the surface of hardened steel at inspection time are now easy prey for steel mill "detectives" who hunt with modern ultrasonic equipment. Ultrasonic inspection of steel is not new, but it has undergone recent improvements to meet the nuclear and missile industries' reliability demands for steel that is free from defects. Under extreme pressure the tiny gas bubbles and slag particles could cause failures in critical operating parts.

Allegheny Ludlum Steel Corporation's Forging and Casting Division at Detroit, Mich., is using the latest ultrasonic equipment. Most forging plants are not required to meet the high inspection standards imposed on much of this division's production. Ultrasonic equipment is used in detecting shrinkage, internal cracks, flakes, concentrations of inclusions, carbide segregations and laminations, as well as particle and bubble defects. The defects are shown on a cathode-ray tube screen very much the same as enemy aircraft is picked up on radarscopes.

The ultrasonic method of detecting depends on a beam of extremely high-frequency sound waves which it projects into the steel. A small physical defect in the path of the beam acts as an obstacle to the beam. At the laboratory, the steel shapes are submerged in water. The water increases the sensitivity of the instrument on thin sections and makes it easier to find minute defects. The ultrasonic waves are generated by a quartz crystal transducer attached to a cable which serves as an electrical connection with equipment housing the cathode-ray tube. A metal rod encloses the section of cable submerged in the water.

The steel sample being tested is not damaged by the ultrasonic examination. Thus, this rapid system is useful in production line work. Before the ultrasonic equipment could be used reliably a background of experience had to be accumulated in the interpretation of the indications on the cathode-ray tube. To do this, comparison standards were established. These are blocks of metal (see illustration) designed with varying amounts of intentional defect, usually created by drilling precise holes in the standard block. These blocks were examined by the ultrasonic device, and the degree of variance with each size hole was recorded. A special set of blocks was designed for each type and grade of metal to be tested. Now, working with the standards, metallurgists can tell from the scope line just where the defect is located and how large it is.

Even small defects in steel forgings are exposed with the latest ultrasonic equipment. Finished forgings are submerged in a stainless-steel testing tank (at right) and checked with high-frequency sound waves for internal defects. Any defect in the forging shows up on the cathode-ray tube screen (center). Standard blocks of metal (left), designed with planned defects, enable technicians to accurately read the ultrasonic scope.

MACHINERY'S Reference Section

REVIEW OF SOME UNCONVENTIONAL METHODS OF MACHINING

A memorandum prepared for
the Defense Metals Information Center
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APRIL 1961

Review of Some Unconventional Methods of Machining

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IN RECENT YEARS, a variety of novel processes for removing metal stock have been used as alternatives to conventional machining methods. They find their widest application for processing materials, such as high-strength and temperature-resistant alloys that are difficult to cut, carbides, and ceramics. Since most of these unconventional machining processes develop comparatively low mechanical forces, they are also useful for processing fragile or flimsy work-pieces. The use of these alternative techniques is expanding because they can economically perform jobs which are difficult or impossible by conventional processes.

The review on which this memorandum is based was prepared for the Defense Metals Information Center. The principles and applications of four electrical machining techniques, as well as some information on chemical and ultrasonic methods, are presented as an aid to defense contractors in planning manufacturing operations.

Electrical-Discharge Machining

The erosion of metals by electric spark discharges was observed by Priestley in 1762, and used for disintegrating metals by Svedberg in 1906. Patents covering the use of electric-arc methods for cutting metals date from 1936, but the bulk of the research on spark-discharge processes has been done in the past ten years.

In contrast to the electric arc, which is a stable thermionic phenomenon, the spark is a transient electric discharge through the space between two charged electrodes. The discharge occurs when the potential difference between the two electrodes is large enough to cause a breakdown in the medium between the electrodes and to produce an electrically conductive bridge or spark channel. When the electrodes are separated by a distance of about 0.001 inch and the gap is filled with a dielectric hydrocarbon oil, a spark will occur at a potential of 25 to 100 volts. The breakdown voltage is lower for narrower gaps. The breakdown potential can be obtained by connecting the two electrodes to the terminals of a condenser charged from a packaged power source. Other types of power supply may also be used to produce the spark.

The phenomenon can be used for metal-cutting because each discharge removes a minute amount of material from the electrodes (a tool and the work) and the discharges can be repeated rapidly. Electrodes of the desired shape are used as tools to control the shape of the work. Tools have been made by casting, extruding, machining, powder-metallurgy processes, and other techniques. Electrical-discharge machining processes are applicable to all materials which are sufficiently good conductors of electricity. In commercial machines the electrical output ranges up to 400 volts.

The spacing between the tool and work is critical, and the feed usually is controlled by servomechanisms. The voltage across the gap normally is used to control the servomechanism, which advances or retracts the tool electrode in its attempt to maintain a constant operating voltage. The dielectric bath in which the work is submerged must provide an efficient cooling medium and also carry away particles produced by the electrical discharge. In addition, the fluid must remain nonconductive until the proper breakdown voltage is attained and then deionize the spark gap rapidly to permit rapid rates of repetitive discharges. Sparking is usually forced to occur at a rate between 20,000 and 300,000 electrical discharges per second.

The electrical circuit used for electrical-discharge machining is shown in Fig. 1. The energy in each spark discharge depends on the following relationship:

$$E = \frac{C\,V^2}{2}$$

where

E = Energy of the discharge in microjoules
C = Capacitance in microfarads
V = Voltage

The spark discharge causes the positive electrode to erode faster than the negative electrode, and so the work-piece is positive in all spark-erosion processes. Authorities do not agree on the mechanism of metal removal. Since the spark has a small cross section, the current density is high, of the order of 10^6 amperes per square inch. Temperatures in the spark have been estimated to exceed 10,000 degrees F. As spark discharge proceeds, the spark channel increases in area; after a few microseconds, the discharge tends to develop an arc-like character. Arcing is undesirable because it causes melting on the surface of the work-piece and structural damage in layers under the surface.

The rates of metal removal by spark-discharge machining processes depend on the electrical parameters, shape, composition, and physical properties of the electrodes, and on the nature of the dielectric fluid. Because the fundamental relationships among these variables are not well understood, it is not possible to predict machining times with great accuracy. With machining equipment built to operate at a constant voltage, the rate of metal removal is often controlled by varying the discharge frequency. The rate of metal removal generally increases with condenser capacity until a maximum is reached for a particular cutting current. The rate also increases with the cutting current to a maximum level set by the severity of gas formation in the dielectric fluid.

Rates of metal removal by the spark-discharge process usually do not exceed 0.06 cubic inch per minute. In general, faster rates of metal removal produce rougher surfaces, as indicated in Table 1. Soviet investigators have developed independent-pulse generators which produce arc-like discharges to increase metal-removal rates by a factor of 5 or 10. Such processes produce rougher surfaces and more surface damage; for these reasons, they have not attracted much attention in this country.

The response of materials to spark-discharge machining processes depends mostly on their thermal properties. Thermal capacity and conductivity, as well as latent heats of melting and vaporization, are important; strength and hardness have no significant effect on cutting rates. It should be emphasized that the tool also has a pronounced effect on permissible cutting rates and hence on relative electroerosive machinability ratings.

In order to control dimensions and minimize tool costs, the ratio of material removed from the tool to the volume removed from the work-piece should be low. This ratio varies with different combinations of tool and work electrodes and with operating conditions. Table 2 gives some information on this subject. The data show that tools significantly better than brass are known for some applications and that a particular tool material may not be best for all work-pieces. Table 2 also shows that the tool–work-piece combination affects the stability of the cutting operation and of the servo system.

Spark-discharge processes can be used to generate almost any geometry if a suitable electrode tool can be fabricated and brought close to the work-piece. The process has been used for:

1. Cutting small-diameter holes;
2. Machining molds and dies for blanking, extrusion, or forging;
3. Blanking parts from sheets;
4. Cutting rods of carbides and metals with poor machinability;
5. Flat or form grinding.

Fig. 1. Electrical circuit used on electrical-discharge machining equipment.

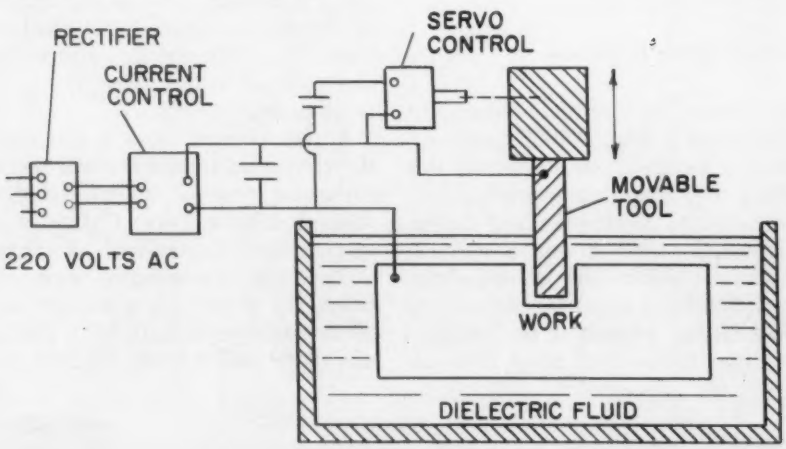


Table 1. Performance Data for Spark-Discharge Machining of Heat-Treated Steel

Conditions	Cutting Rate, Cubic Inches per Minute	Surface Finish, Micro-Inches	Dimensional Tolerance, Inch*
Roughing	0.06	50	0.004
Semifinishing	0.008	18	0.003
Finishing	0.0005	5	0.001
Superfinishing	0.0001	2	0.0005

*Data are for operations with a 2.758-inch diameter copper electrode cutting to a depth of 0.473 inch.

Courtesy: Sundstrand Corporation

Holes of almost any shape and size can be produced by the electrospark process because tool rotation is not essential. The trepanning principle should be used, when practical, to reduce machining time. Tolerances as low as 0.0005 inch can be held with slow rates of metal removal. Since the process does not require mechanical pressure, billets can be cut with rotating bands or discs or with a thin sheet of metal as the electrode. "Cookie-cutter" type electrodes are suitable for blanking tools. Using thin tools minimizes kerf losses, an important consideration when expensive materials are processed. Electrospark grinding operations are usually performed with brass-wheel electrodes rotating at 50 to 100 rpm. The spacing between wheel and work ranges around 0.00017 inch. Material-removal rates on cemented carbides and hardened steels average about 0.004 cubic inch per minute when producing a finish of about 60 micro-inch.

The surface of spark-machined work-pieces has a matte finish created by closely spaced craters. The size and shape of these pits are controlled by the electrical parameters, the electrode materials, and the dielectric fluid. Depending upon the surface condition, electrical-discharge machining may or may not have an influence on the microstructure and mechanical properties of the work-piece surface layers.

Electrolytic Grinding

The process commonly termed electrolytic grinding was developed around 1952, primarily to reduce the requirements for industrial diamonds in cutting and grinding cemented carbides. It is essentially an electrochemical deplating process and can be used on any electrically conductive material. Unlike the electrical-discharge processes, the most common variation of the electrolytic-grinding process is not adapted to cavity-sinking operations. In general, it is better suited to metal-removal applications ordinarily performed by cutoff wheels, saws, or grinding and milling machines. The process has been applied successfully to removing material from refractory metals, high-strength steels, carbides, and nickel- and cobalt-base alloys.

Electrolytic processes for removing metal depend on the fact that the passage of electrical current through an electrolyte is accompanied by a movement of ions to the opposite electrode of the circuit. Material can be dissolved and removed from a work-piece in a suitable electrolyte if the opposite electrode is anodic. There are at least two different metal-removal processes or techniques covered by the term electrolytic grinding.

The process originally called electrolytically assisted grinding is the one most widely used and will be described first. Fig. 2 illustrates the setup used for many applications. The equipment is similar in appearance to conventional grinders, except for the electrical accessories. However, about 95 per cent of the metal removal results from electrolytic rather than mechanical action.

This version of the electrolytic-grinding process is characterized by:

1. A rotating cathode containing abrasive particles;
2. An essentially neutral electrolyte;
3. A static or mildly agitated bath of electrolyte.

Aqueous solutions of sodium silicate, borax, or sodium nitrate and sodium nitrite are ordinarily used as electrolytes. An electric current is passed through the bath to dissolve the anodic surface of the work-piece. The resultant film of insoluble salts or oxides is then scraped away by the rotating grinding wheel. Metal-bonded diamond wheels are commonly used in this country for electrolytic grinding of carbide tools. Graphite-filled, current-conducting abrasive wheels made of equal parts of graphite and alumina have been used in Russia. One of the important functions of the abrasive grains is to create a space for the electrolyte between the current-conducting bonding material in the wheel and the surface of the work-piece.

Direct current from a generator or pulsating direct current from a rectifier supplies the energy for metal removal. Rough grinding can be performed with a current density of 125 to 195 amperes per square inch of contact area and a voltage not exceeding 30. Fine grinding is done below 15 volts with a current density of about 30 amperes per square inch. For constant values of voltage and current, the rate of metal removal

depends on the pressure between the wheel and the work. Pressures of about 28 to 45 pounds per square inch are optimal; pressures exceeding this level by a factor up to 3 do not noticeably improve productivity and may lower precision. Electrolytic grinding can be carried out successfully at speeds used for conventional grinding; that is, from 3000 to 6000 fpm.

The composition of the electrolyte influences the surface finish, precision, and stock-removal rate of the operation. Wear on the electrode tool is negligible, in the order of one-half that for conventional wheels when grinding carbides. The process does not damage the surface of the work-piece, and metal-removal rates are relatively high. For example, with a 3-inch wheel or disc face, a cut 0.01 inch deep can be taken on a 3- by 6-inch surface of cemented carbide in two minutes. If suitable tool electrodes and sufficient electrical capacity are available, the speed of metal removal is independent of cut width. The area of contact limits the current which can be drawn without spark discharges and thus influences maximum machining rates. For equal current efficiencies, the rate of metal removal is proportional to the current and the electrochemical equivalent weight of the work-piece.

An alternative process for finishing or shaping uses electrolytes capable of dissolving the reaction products. With this technique, an abrasive wheel is not used for electrolytic grinding or milling because no mechanical contact between the tool and work-piece is required.

Electrolytic Machining

Some true electrolytic-machining procedures for generating shaped cavities and contoured surfaces have been developed and used to a certain extent in production operations. These new processes employ electrolytes which dissolve the reaction products formed on the work-piece by electrochemical action. Electrolytic machining is also characterized by a plunging action of the tool electrode and rapid circulation of the electrolyte. Published information on the electrolytic cavity-sinking process is meager, probably because the patent situation is unsettled. Therefore, the following general comments are based on only one application of the process, the electrolytic slicing of billets of various high-temperature alloys. This method was developed by Messrs. Faust and Clifford, and co-workers of Battelle Memorial Institute.

Tools of brass or stainless steel showed negligible amounts of wear when cutting titanium, hardened steel, or several high-temperature iron-base alloys. An aqueous solution of sodium chloride and boric acid was an adequate electrolyte for the iron-base metals. An acid-fluoride solution was required for electrolytic cutting of titanium.

In experiments, brass or stainless-steel discs rotating at speeds up to 17,500 fpm were used as cathodes. In some of their experiments the electrolyte was directed at the hub of the cutoff discs and flowed radially to form a thin film in the cutting zone. The velocity of electrolyte flowing

Table 2. Electrical-Discharge Machining Characteristics of Various Electrode-Material Combinations

Electrode Combination		Current, Amperes	Removal Rate, 0.001 Cubic Inch per Minute	Wear Ratio*	Machine Stability
Tool	Work-Piece				
Copper	Copper	8	0.39	0.3	Poor
Copper	Iron	12	0.95	0.5	Fair
Copper	Titanium	10	2.8	0.1	Poor
Aluminum	Copper	12	0.88	1.6	Good
Aluminum	Iron	8	0.53	1.7	Fair
Aluminum	Titanium	10	0.16	8.0	Fair
Iron	Copper	12	2.0	1.3	Good
Iron	Iron	8	0.20	2.5	Poor
Titanium	Iron	10	0.30	2.5	Fair
Titanium	Titanium	22	0.03	2.0	Poor
Brass	Steel	(15)	2.9	1.0	...
Brass	Cemented carbide	(15)	2.0	3.0	...
90 W - 10 Ag	Steel	(15)	2.8	0.05	...
90 W - 10 Ag	Cemented carbide	(15)	3.4	0.14	...
65 WC - 10 Ag	Steel	(15)	2.2	0.08	...
65 WC - 10 Ag	Cemented carbide	(15)	1.7	0.21	...
50 Cu - 50 C	Steel	(15)	10.0	0.34	...
50 Cu - 50 C	Cemented carbide	(15)	...	...	...

*Ratio of volume of metal removed from the tool to the volume of metal removed from the work-piece. Lower wear ratios are preferable.

Courtesy: Cincinnati Milling Machine Co.

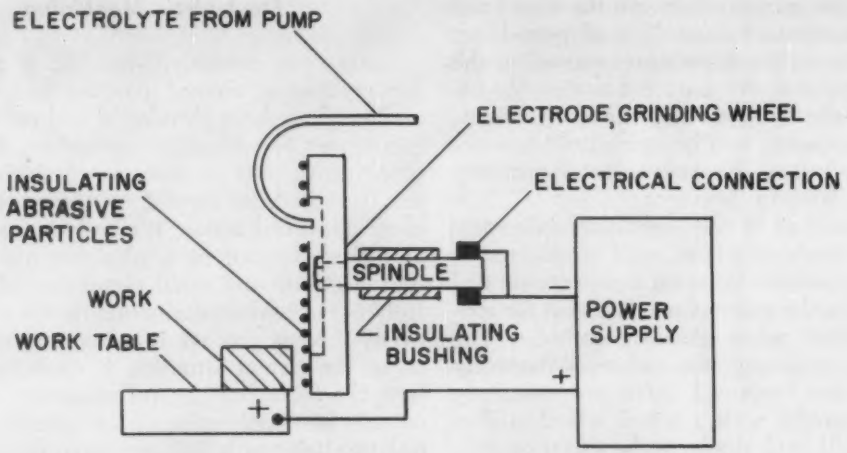


Fig. 2. Diagram illustrating the principle of the electrolytic-grinding process.

through the cutting zone was directly related to the speed of disc rotation. A high flow rate was found desirable to bring in fresh electrolyte, to sweep out the reaction products, and to minimize the temperature of the electrolyte in the cutting zone. Cutting could be accomplished by feeding the work into the rotating tool or vice versa.

For best dimensional control and efficiency, the noncutting areas of the tool should be insulated. In cutting-off experiments, this was accomplished by painting the sides of the disc or by not flooding the cutting zone with electrolyte. Optimum results in cutting 1-inch round bars were obtained with voltages of 10 to 12 and a spacing of 0.001 to 0.004 inch between the work and the tool. Under such conditions, a disc 0.043 inch thick produced cuts about 0.063 inch wide. Cutting rates followed Faraday's law in terms of current density; plunge-cutting rates were as high as 0.085 ipm. Current densities as high as 1240 amperes per square inch were measured.

Electrolytic machining will probably compete with electrical-discharge methods rather than with electrolytic grinding for producing holes, shaped cavities, and contoured surfaces. The electrolytic process offers the advantages of negligible tool wear and no surface damage to the work. It has been found possible to remove 0.10 cubic inch of metal per minute over an area of 1 square inch by the electrolytic process.

Chemical Milling

Chemical milling is a process for shaping metal parts by controlled attack with suitable chemical reagents. The name originated from early applications in which the technique was used as a substitute for milling operations. Chemical milling is particularly useful for removing metal from thin sections and from complex contours, as well as for removing small amounts of metal from large areas. Parts requiring the removal of metal from all surfaces are immersed in an appropriate solution for a suitable period of time. Selective attack on different areas of the part can be controlled by partial immersion or by masking to protect certain areas of the work from chemical attack.

In early applications of the process, a rubber coating used for masking was applied to the work by dipping, spraying, or brushing. The mask was then scribed and taken off the areas from which metal was to be removed. By a series of etching and mask-removing operations, steps of various depths could be produced. Since these early techniques, considerable effort has been devoted to developing masking materials for various chemical solutions, and to improving methods of applying them. For example, the application of masks by silk-screen or photographic processes has eliminated scribing and some of the steps involved in removing masks.

Chemical milling has been applied commercially on most wrought aluminum and several magnesium alloys. A limited amount of commercial work has been done on steel and titanium. Reasonably extensive bench-scale experiments have been carried out on high-strength steels, stainless steels, and several high-temperature alloys. Preliminary studies have been carried out on the chemical milling of beryllium, zirconium, tungsten, columbium, and molybdenum. It ap-

pears that suitable etching solutions for these metals may be available.

Difficulties in holding tolerances during chemical milling are closely related to the depth of cut. Cuts deeper than 0.25 inch have been made successfully, but the process is more suitable for lighter cuts. Under some conditions, processors can offer production tolerances, on thickness, of 0.001 inch for a variety of etch depths. The solutions etch beneath the mask as they etch down through the work by an amount of from 50 to 125 per cent of the etch depth. Therefore, some allowance must be made for deviations from lines on the pattern. The line tolerance that can be held amounts to about plus or minus 5 per cent of the depth of cut. Fillet radii on chemically milled stepped sections usually approximate the depth of the step. Surface finishes can vary from 10 to 250 micro-inches, depending on the material, cut depth, and characteristics of the etchant.

Chemical milling may or may not affect the mechanical properties of the work-surface, depending on the etchant and the metal involved. In general, chemical milling has little or no effect on the properties of aluminum and magnesium. Titanium alloys pick up hydrogen during chemical milling with some reagents and sometimes require vacuum degassing.

Ultrasonic Machining

Ultrasonic machining is a process used to cut hard materials by bombarding them with tiny abrasive particles traveling at high velocities. The abrasive is carried in a liquid flowing between the work and a tool which oscillates with a stroke of 0.002 to 0.004 inch at approximately 20,000 cycles per second. The equipment includes an electronic generator which converts 60-cycle alternating current into high-frequency power supplied to a magnetostrictive type transducer. The transducer converts the electrical energy into mechanical energy, causing the tool to vibrate linearly at ultrasonic frequency. The tool drives the abrasive grit into the work, removing minute particles of the work with each stroke. The rapid motion of the tool face producing cavitation of the abrasive slurry also pumps away the debris from the site of the cutting action.

The maximum cross-sectional area of the tool is limited by the capacity of the transducer. The generator and transducer capacities of general-purpose machines range from 50 to 2400 watts. Such machines can produce holes ranging from 0.001 to 3.5 inches in diameter to depths up to 5 inches. The tool for ultrasonic machining is braxed, soldered, or fastened mechanically to a tool-holder threaded to the transducer. The tool, which determines the shape and contour of the cavity to be produced, is usually made from soft steel. The size of the tool is influenced by the accuracy and surface finish required on the work. Ordinarily the tool is 0.003 to 0.004 inch smaller than the cavity it produces. Better precision and smoother finishes are obtained by using more than one tool and grit size for each cut.

Boron carbide, in grit sizes ranging from 240 to 800, is commonly used for the ultrasonic machining process. Silicon carbide and alumina have also been used for abrasives. The rate of stock removal, the dimensional precision, and the surface finish depend on the fineness of the abrasive. In roughing operations a 25 micro-inch finish can be obtained with 280 grit; a 10 micro-inch finish requires up to 800 grit. Tolerances of 0.002 inch are generally obtained with 280 grit. A tolerance of 0.0005 inch or better can be secured with finer abrasives. For best results, it is common practice to follow roughing cuts with one or more finishing operations employing progressively finer grits.

The typical operations performed by ultrasonic-machining techniques might be classified as engraving, slicing, drilling of single or multiple holes, broaching, shaving, and cavity sinking. The process is best suited to materials which are both hard and brittle. The technique has been used successfully to shape hardened steels, gem stones, carbides, ferrites, aluminum oxide, glass, and many other ceramic products. Carbon, graphite, Formica, and some plastics can also be processed by the ultrasonic-machining process. The process does not produce any change in the chemical, metallurgical, or physical properties of the work.

Electron-Beam Machining

The use of electron-beam equipment for melting and welding has attracted considerable interest in recent years. Electron-beam units usually operate in vacuum chambers at pressures of 10^{-4} to 10^{-6} millimeters of mercury. It is possible to operate the equipment in inert gases at low pressures, but there seem to be no advantages in this modification. Tungsten filaments heated by resistance are ordinarily used as electron emitters. The beam of electrons is focused by magnetic and electrostatic lenses. The energy of the electrons depends on their mass and speed; by using high accelerating voltages, high velocities are obtained. The voltage drop of interest is the one existing between the emitting filament and the anode of the circuit. Ordinarily the first lens in the focusing system rather than the work is

the anode. Standard equipment capable of delivering up to 10 million kw per square inch on small areas, say 0.001 square inch, is marketed for welding purposes. Some laboratory-scale apparatus for electron-beam welding operates at 20,000 volts. Under such conditions it is no problem to shield operators from X-rays.

Electron beams can also be used for drilling, slotting, and cutting. The metal is evaporated from localized regions in the work-piece by attaining temperatures as high as 9000 degrees F. One of the problems is to do this without causing thermal damage to the work. Better voltage and current controls and more precise focusing lenses are required for machining than for welding. Some designers believe that these requirements point toward higher-voltage electron-beam equipment for machining applications. Equipment operating at 125,000 volts has been used for this purpose, but it requires lead shielding to stop harmful stray radiation.

Because the large amount of energy in the electron beam can be concentrated on a small area, the technique can be applied to processing jewels and refractory materials. Electron-beam machining processes seem best suited to profile or line cutting of thin work-pieces, slotting, trepanning, and "drilling" small holes. In one application holes are drilled in stainless-steel spinnarets 0.030 inch thick within tolerances of 0.0001 inch. The electron beam used for the purpose is approximately 0.0004 inch in diameter. To avoid thermal damage to the work, the beam is pulsed; each pulse strikes a slightly different spot. It is usually impossible to move the work fast enough to avoid damage to cut surfaces. For this reason, and to hold dimensions precisely, control is usually exercised by deflecting the electron beam rather than by moving the torch or work.

The fact that electron-beam machining has to be carried out in a vacuum chamber is not considered a major disadvantage. Chambers at least as large as 3 by 3 by 20 feet have been used for electron-beam welding. Furthermore, many refractory metals must be processed in vacuum systems or high-purity atmospheres in order to avoid contamination.

Plasma-Arc Cutting

Plasma arcs have been used for cutting a variety of metal, "plasma" being a term used to denote the state in which matter exists as electrons and ions. An electric arc operating in the open air produces plasma because the electrons flowing in the arc first ionize and then dissociate the gases that make up the air. Temperatures in open-air arcs reach about 10,000 degrees F. Higher temperatures are obtained when collisions occur more frequently between the gas molecules and the high-energy electrons. In fact, it has been calculated that temperatures as high as 60,000 degrees F. have been produced by constricting the arc with the transferred-arc types of tools used for metal-cutting. At the left in Fig. 3 is a sketch of such an arc applied to metal-cutting. The work serves as one electrode; the gas separates the arc from the metal walls of the nozzle. Such a device has been used for line-cutting sheets and plates, and might be adaptable to more complicated metal-removal operations.

At the right in Fig. 3 is a sketch showing a nontransferred plasma arc which produces an electrically neutral, high-temperature stream of plasma. This type of device is used to produce a "plasma flame" for metal spraying. Plasma arcs have been used for cutting steel sheets and plates. Because of their characteristically high temperatures, plasma arcs could also be used for profiling or line-cutting operations on refractory materials.

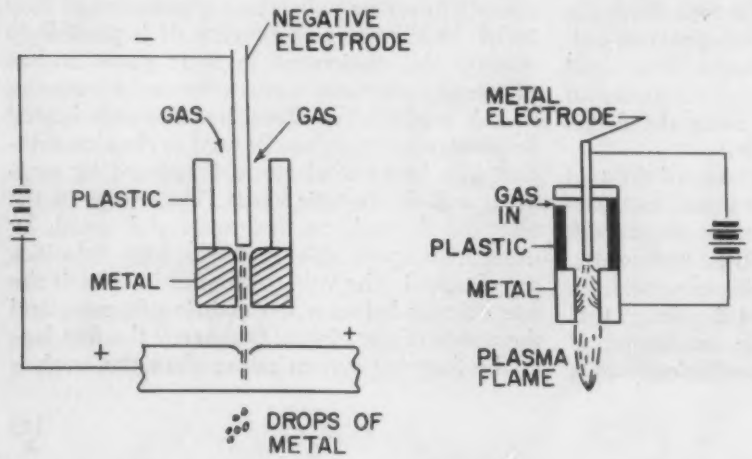


Fig. 3. Two types of plasma arcs employed for metal processing. At left, transferred arc; at right, nontransferred arc.

Open-Air "Tig" Welding Fabricates Complex Underwater Pipeline

T. ANDERSON and E. L. TRIMBLE, Linde Company

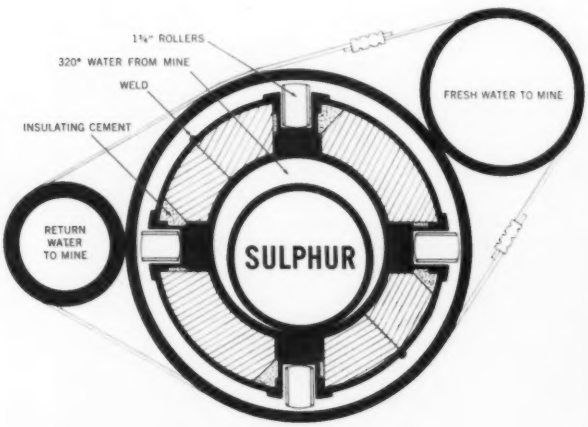
ONE of the most complex pipelines in engineering history runs from the shore of Grand Isle, La., to the Freeport Sulphur Co.'s man-made island in the Gulf of Mexico. This 7-mile line transports molten sulphur from the new offshore mine directly to insulated tank barges. The steel island is the biggest permanent structure in the Gulf, dwarfing nearby oil-drilling platforms.

"Tig" welding helped assemble this most unusual pipeline. It actually consists of three concentric pipe and two "piggyback" lines buried in a soft clay trench 50 feet beneath the waves.

A 6-inch diameter sulphur line runs inside a 7 5/8-inch diameter hot-water line. The latter, jacketed with 2 1/4-inch thick calcium-silicate insulation and aluminum foil, is centered within a 14-inch diameter outer pipe by 1700 rollers. A high-temperature coal-tar and glass-fiber wrap insulates this outer casing. Carried "piggyback" are a 4-inch diameter water-return line plus a 6 5/8-inch diameter fresh-water line.

Welding of the J&L Jalloy No. 1 steel pipe took place on Grand Isle, with the 2000-foot fabrication line extending across almost the full width of the island. Ends of the 6-inch and 7 5/8-inch diameter pipe were machined to a J-bevel and buffed bright to avoid foreign inclusions. Then a Solar-Flux mixture in methyl alcohol was painted in a 1-inch wide band inside each pipe joint. Butt joints were then root-pass fusion welded by Linde's Heliarc process. The 1/16-inch land of the U-groove joint was fully penetrated by the extremely hot arc of the 2 per cent thoriated-tungsten electrode, while argon gas kept the welds shiny and oxide-free. The first cover pass was Heliarc welded, using a bare 1/8-inch diameter filler rod of approximately the same chemical composition as the Jalloy pipe. Final build-up passes were made with conventional arc welding, using low-hydrogen rods.

All testing and assembly of the welded lines had to be accomplished on the island, limiting the test lengths to 1000 and 2000 feet. Completed welds received 100 per cent radiographic inspection, followed by hydrostatic testing at 1350 psi for the 6-inch diameter line, and at 1800 psi for the 7 5/8-inch diameter line.

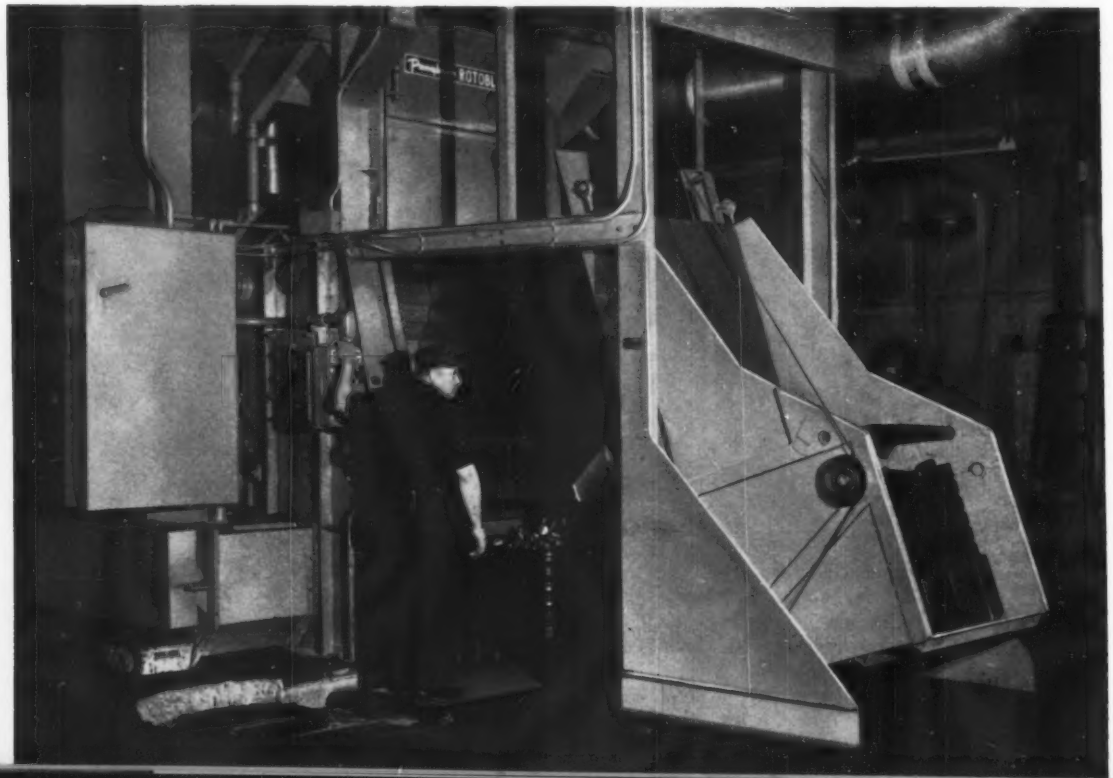


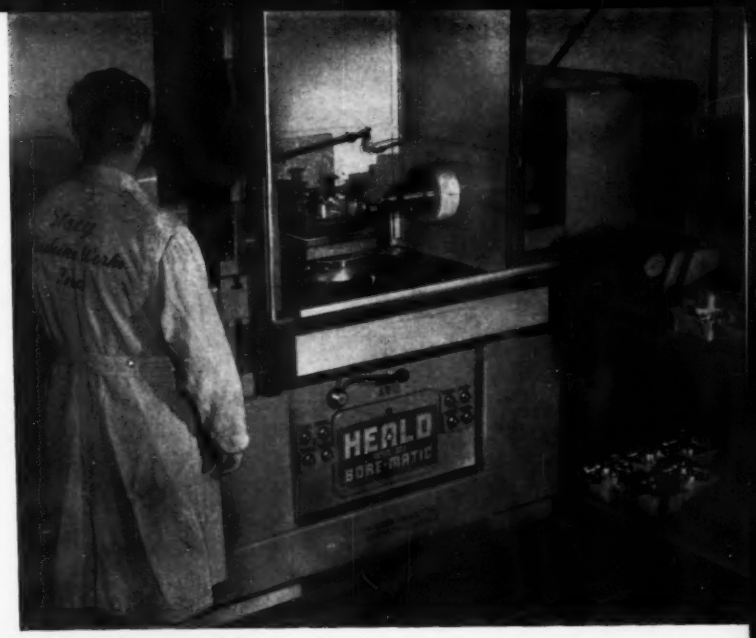
Cross section of 7-mile long pipeline for transporting molten sulphur from offshore mine to insulated tank barges.

On-the-spot Heliarc fusion welding with filler rods joins sections of steel pipe into 1000-foot lengths for molten-sulphur line.

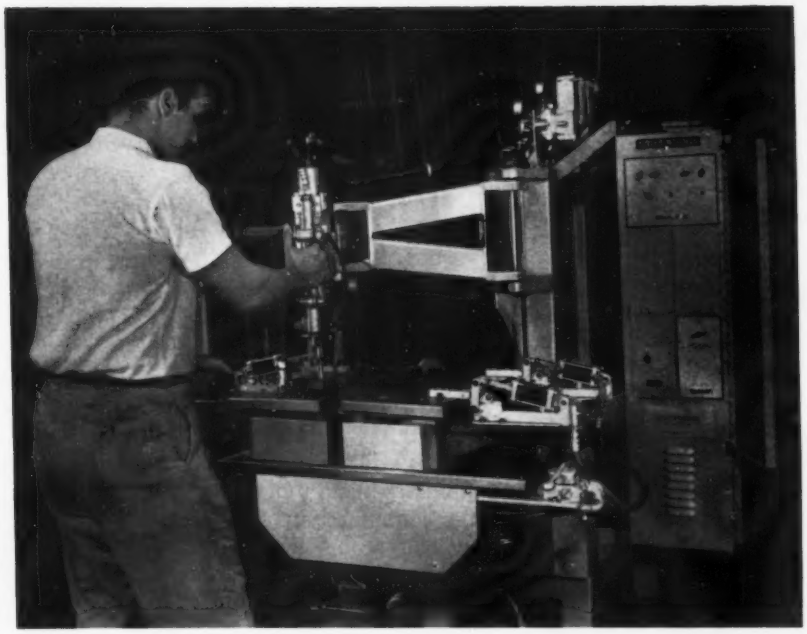
BLAST CLEANING — Scale, rust, and minor burrs are quickly removed from forgings, castings, and stampings at Rockwell-Standard's Universal Joint Division in Allegan, Mich. The 15-cubic-foot barrel of this heavy-duty Pangborn Rotoblast machine (bottom)—which replaces two smaller, but similar, units—handles 60 to 80 tons of work in a sixteen-hour day. Most loads range from 2000 to 4000 pounds and are cleaned in a six-minute cycle. Push-button controls stop the blast action, open the abrasive-tight door, and reverse the work conveyor to discharge the batch (left).

In Shops Around the Country

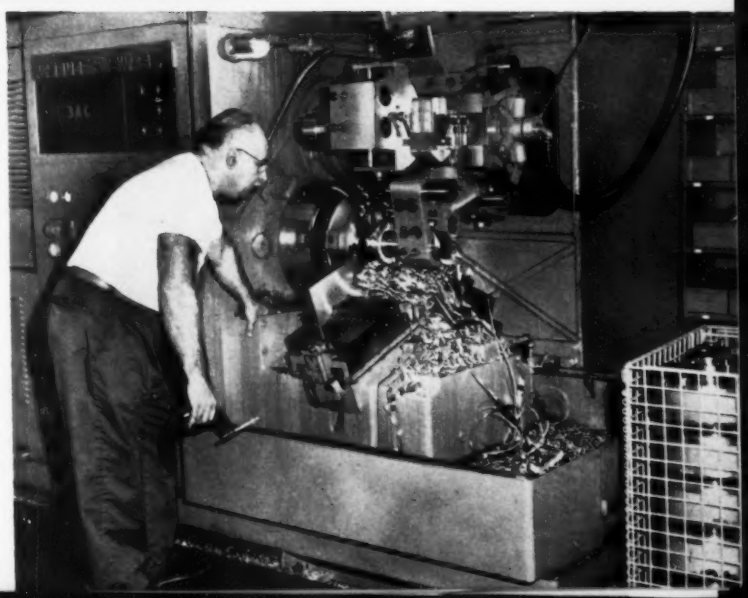




PRECISION BORING — Seventeen bores in an aluminum hub assembly for Sparrow III missiles are handled in only five setups at the Stacy Machine Works, Agwam, Mass. A 5- to 8-micro-inch finish is achieved in eight small piston bores that are a part of the fin guidance system. High-pressure coolant fed through the hollow tool-spindle on this double-end Heald Bore-Matic carries away chips and helps produce the smooth bore finish.



ARTICULATED WELDER — The gap between standard and one-of-a-kind machines has been filled for John J. Nesbitt, Inc., Philadelphia, Pa., by this Taylor-Winfield articulated-beam spot welder. A jointed beam allows a single upper electrode to be positioned at any point within a 30- by 30-inch area. Front and back of a cabinet sliding-door panel are being joined. Air-operated clamps secure the panels while the operator guides the electrode into spot locators.



WEIGHT REDUCTION — Fifty-nine pounds of metal are removed from bronze bottom-grid castings in two operations at the Westinghouse Electric Corporation's plant in Trafford, Pa. In this first chucking—on one of two Warner & Swasey 3-AC single-spindle automatics—fifteen carbide cutters hog off 37 pounds of metal from the 103-pound casting, while holding the bore diameter within 0.003 inch. The part is reversed for the second operation on an identical machine, where six carbide cutters remove another 22 pounds.

Ultrasonic vibrations applied to the cutting surface of a grinding wheel through a water-base coolant can prevent metal-particle build-up or loading. The wheel can be maintained in a free-cutting condition until the abrasive particles wear smooth and the glaze point is reached. Consequently, wheel wear, the need for dressing, and the frictional force and heat of grinding are substantially reduced. Without the loading problem, harder-grade wheels may be used for soft materials, and difficult-to-grind metals are ground more economically. Surface finishes have been significantly improved

Ultrasonics Creates a Major Innovation in Surface Grinding

HAROLD W. BREDIN, Associate Editor

BUILD-UP OF METAL PARTICLES on the surface of a grinding wheel can be virtually eliminated by a unique application of ultrasonic principles. They are embodied in a system called "Ever-Grind," developed by the Cavitron Corporation, Long Island City, N. Y., for use as an accessory on surface-grinding machines. A typical setup, employed at the Lycoming Division of AVCO Corporation, Stratford, Conn., is seen in the heading illustration.

Essentially the equipment consists of a source of intense ultrasonic vibrations, called a transducer, placed in close proximity to (actually within a few thousandths of an inch of) the cutting surface of the grinding wheel, and a water-base coolant is pumped through the transducer into the space between the output end of the transducer and the work. The physical conditions and the design of the output end of the transducer

Fig. 1. Close-up view of the ultrasonic attachment mounted above the wheel of a reciprocating surface-grinding machine. Cover is removed to show the transducer construction.

are critically important for successful operation of the method. Transducer vibrations in the 20,000-cycle-per-second range are transmitted by the coolant to the wheel surface, where special features of the output end of the vibrator cause an effective loading preventive action. As a result of this action, minute metal particles that would normally tend to cling to the wheel and become embedded are removed.

Although the transducer can be positioned radially at any angle, it is usually placed vertically at the top of the wheel. Transducer tools for wheels up to 2 inches wide are available at present. A close-up view of a transducer (with cover removed) mounted at the top of the wheel of a reciprocating surface-grinding machine is shown in Fig. 1. Application of the process is not limited to surface-grinding machines, as the setup can be used wherever the wheel is accessible.

In ordinary use grinding wheels begin picking up small pieces of metal from the first revolution in contact with the work. As operation continues, these particles build up on the wheel and weld to each other, causing loading. When loading becomes excessive, the cutting action ceases and the increase in friction between the work and the wheel burns the work. At this point the operator must stop grinding and dress the wheel.

The Ever-Grind process does not clean the wheel, since in the first revolution very fine particles of metal do get between the abrasive grains. What the process does is to prevent any build-up of metal on these small nuclei particles that have entered the wheel. Thus loading is prevented to the extent that it has little, if any, effect on the grinding process.

Essentially, the wheel is maintained in a free-cutting state for a longer period of time. Although build-up is held to a minimum, abrasive grains in the wheel do, however, eventually become dull and the wheel ceases to cut. When this condition is reached, the wheel is said to be at the glaze point and has had ultimate use before redressing.

Since particle build-up does not occur and the abrasive grains remain free-cutting for an extended period of time, wheel life is correspondingly lengthened. In addition, wear of the wheel during grinding is reduced to a minimum. This can be an important consideration in using the process for automated grinding setups. In some cases wear has been one-tenth of that in similar grinding operations performed without the use of the ultrasonic equipment. With less wheel wear, the need for dressing is reduced, thus minimizing the down time necessary for this purpose.

Grinding Time Cut Almost in Half and Re-dressing Eliminated

At the Lycoming Division plant, the ultrasonic equipment was installed on an Arter rotary surface-grinding machine. In one operation, the process was used to grind an overhanging flange surface on a forged AMS-6470 nitriding-steel part (Fig. 2) having a hardness of 67.5 to 70.5 Rockwell A. It had been normally difficult to hold the surface parallel to within the 0.0005-inch tolerance required. For roughing, a 15-inch diameter Peninsular FA-60-J9-VB wheel 1 1/2 inches wide was employed at a wheel speed of 6000 sfpm. Work speed was 280 sfpm, the cross feed was 2 ipm, and the automatic down feed was 0.0005 inch per pass. Total stock removal was 0.012 inch per part over the surface of the 1 3/8-inch wide by 14 1/2-inch diameter flange. With the process, floor-to-floor time was cut from thirty to seventeen minutes and dressing was not required after a run which totaled eleven pieces. Without the process, the wheel had to be dressed after every three pieces. A later finishing operation on the same part showed approximately the same results in floor-to-floor time, but wheel dressing which was normally required after every piece was not necessary for an entire run of twenty pieces.

Maintaining a free-cutting wheel permits the grinding of thin-gage work with little warpage, as the grinding force required is relatively small and the heat developed due to friction is

Fig. 2. Production time for grinding the top flange of this steel forging was cut almost in half by use of the ultrasonic accessory. The need for re-dressing was completely eliminated for both roughing and finishing operations.

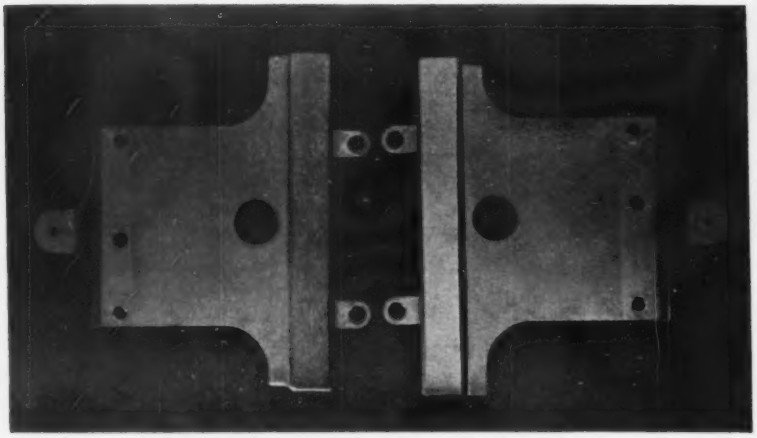


Fig. 3. The bosses on these two fragile 0.040-inch thick parts were ground under the same conditions with (right) and without (left) use of the ultrasonic process. Piece at right has 10-micro-inch finish, but chatter and loading developed in conventional grinding to cause poor finish on piece at left.

low. At the plant of a large computer manufacturer, a 3/8- by 2-inch boss was required to be ground on a 0.040-inch thick formed steel part (Fig. 3). The dimensional tolerance was plus or minus 0.001 inch, and a smooth finish was necessary. Unless the wheel were free-cutting, this fragile part would chatter and the accuracy and finish would be poor. With the ultrasonic process, 308 parts were ground in less than eight hours on one wheel dressing and a 12-micro-inch finish (average) was maintained. In Fig. 3, a comparison of surface finishes obtained on the parts ground with (right) and without (left) the process is shown. The same grinding conditions were used in both cases.

Surface finish is significantly improved by the process. In one application at the Grumman Aircraft Engineering Corporation, Bethpage, N. Y., a Type 304 stainless-steel 12-inch diameter part, called a vacuum plate, was required to have an 8-micro-inch finish. The operation was performed on a reciprocating surface-grinding machine equipped for the ultrasonic process. In operation a downfeed of 0.0005 to 0.0007 inch, a cross-feed of approximately 0.015 inch, and a table speed of 60 fpm were employed. Over-all stock removal was 0.004 inch. The wheel, which was a National MA-80L-10V6W 12 inches in diameter and 1 inch wide, was in a clean condition after grinding. No loading or burning occurred, and a 4-micro-inch surface finish, measured with a profilometer, was achieved.

Difficult-to-Grind Metals Ground More Readily

If loading is prevented, soft metals such as brass, aluminum, and magnesium can be ground with harder-grade wheels. As a result the wheel inventories required in some cases can be reduced. Difficult-to-grind metals are also reported to be ground more readily. Of the two grooves plunge-ground in the Type 303 stainless-steel test part seen in Fig. 4, the shallower one was ground in the regular manner to a depth of 0.127 inch. At this point the wheel was loaded and a 60-micro-inch finish was obtained. The deeper groove was plunge-ground 0.337 inch, using the ultrasonic attachment under the same grinding conditions. A 35-micro-inch finish resulted, with the wheel remaining essentially clean. Dressing before re-use was not required.

In another test on Type 303 stainless steel, made under identical conditions, regular grinding removed 0.057 inch, leaving a 35-micro-inch finish, and wore the wheel 0.009 inch. With Ever-Grind, 0.108 inch was removed, an 8-micro-inch finish was obtained, and the wheel wore only 0.0015 inch.

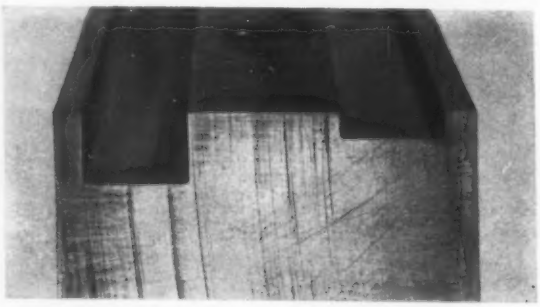


Fig. 4. Groove at right in this Type 303 stainless-steel test piece was plunge-ground until wheel needed dressing. Same wheel, equipped with the ultrasonic accessory, remained essentially clean after plunge-grinding the much deeper groove at left to a 32-micro-inch finish.

Harold Lindsay Gray

Harold L. Gray, secretary and director of THE INDUSTRIAL PRESS, and publishing manager of MACHINERY and AIR CONDITIONING, HEATING AND VENTILATING, passed away suddenly in his home on the night of February 28. He had spent the day in the offices of the company attending sessions of the annual sales conference and was apparently in the best of health. He was sixty-seven years of age.

Mr. Gray started with THE INDUSTRIAL PRESS in August of 1917 and spent over forty-three years in the advertising department. He headed the activities of that department for many years, at the same time functioning in his capacity as a corporate officer.

Mr. Gray was an elder of the Second Presbyterian Church of Rahway, N. J., where he resided. Another of his special interests was Camp Endeavor Inc., a summer camp for underprivileged children. He became interested in this organization at the age of ten, was president for twenty-five years, and at the time of his death, was vice-president.

Surviving are his widow, Alice S. Gray; three daughters, Mrs. Janet G. Silvers, Mrs. Elizabeth G. Drisko, and Mrs. Kathryn G. Pearson; and nine grandchildren.

Harold Gray had a high concept of publishing ethics, which won him universal respect. In private life, he was greatly admired for his ideals, innate modesty, and humane attributes. He will be greatly missed by his business associates and many friends.

Calibration of Gage-Blocks

Gage-blocks are currently being calibrated at the rate of 5000 to 6000 a year by the laboratory of the National Bureau of Standards. Thus, the bureau provides industry with one of its most effective means of monitoring the increasingly close dimensional tolerances required for the interchangeability of parts and reliable performance in complex modern devices. In special cases it has been possible to certify gage-blocks to an accuracy of less than one part in 5,000,000. Research is under way at the NBS to find alloys for calibrations to one part in 10,000,000.

The first step in the bureau's calibration procedure is to test the gaging surfaces for flatness and parallelism. Blocks with excessive deviations in either respect are, as a rule, not calibrated; but if they are, the accuracy is not certified. In maximum precision applications, it may be necessary to take into account even small deviations, since lack of flatness (parallelism) means that the length of the block will vary from point to point on the gaging surfaces.

The lengths of all blocks submitted for calibration are then determined by comparison with NBS master blocks of the same nominal size. These master blocks are calibrated against the laboratory's reference standards, light waves produced by cadmium and mercury 198. The lengths of these light waves are known accurately in terms of the new international standard of length, the wave length of the orange-red spectral line emitted by atoms of krypton 86. Electromechanical comparators of the dual transducer type show the difference in length between master block and test block. Each test block is compared at least twice with the master blocks. Tongs are used to handle the blocks so that variations from 68 degrees F. will be held to a minimum.

Data from the electromechanical comparators are recorded on punched cards for processing in a high-speed electronic computer which calculates the deviation of each block from its nominal length. In arriving at an average value for the block, the computer examines both comparisons for excessive spread or variation between their values.

Work-handling time cut by setting up for . . .

RECIPROCAL MILLING

The idea of reciprocal milling dates back many years. That early attempts to use this technique met with but limited success can be traced to excessive backlash between the table feed-screw and nut in older machines. Now, with the advent of automatic backlash eliminators for table-drive mechanisms, both conventional and climb milling can be handled with equal ease

A. A. HECKMANN
Manager, Engineering Service, Milling Machine Division
Cincinnati Milling Machine Co.

IN RECIPROCAL MILLING a fixture is located at each end of the table, permitting one to be loaded and unloaded while the work-piece held in the other is being machined. Although such setups are not entirely new, they merit discussion because of the large savings they afford. Work-handling time need not be added to machining time, as both are done simultaneously. There are many instances where this system can be used for large or small parts, or in combination with other milling methods.

An example of simple reciprocal milling is illustrated in Fig. 1. Two hydraulic clamping fixtures are mounted on either end of the table. This 50-hp vertical machine is tooled up to mill the flange mounting face on gate valves and will accommodate twenty-six different sizes, ranging in bore diameter from 2 to 10 inches. Stock removal varies from 3/16 to 5/16 inch, depending on the size of the part. Production rate for the 10-inch bore diameter valve is 25 per hour.

In another case reciprocal milling is being employed to advantage in cutting a small slot in the top of insulator caps. Tooling consists of a single-station work-holding fixture at each end of the table, a vertical milling attachment, and a two-

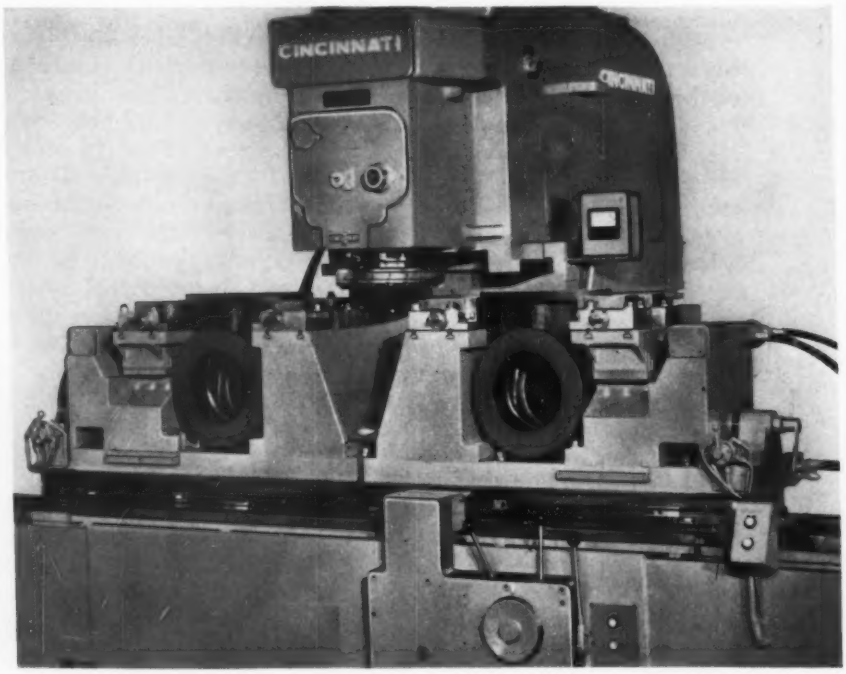


Fig. 1. Two hydraulically operated clamping fixtures are set up for the reciprocal milling of gate valves from 2 to 10 inches in bore diameter.

way feed arrangement with a dwell attachment to control the machine cycle. Approximately 67 parts per hour are completed—a high rate for an operation in which only one part is milled at a time.

Reciprocal milling is often combined with other types of setups to obtain the advantages of both. For example, two or more work-pieces may be placed abreast—that is, in a row that is aligned at a right angle to the direction of table feed. By placing a similar setup at each end of the table, it can be combined with reciprocal milling.

An operation of this type, in which two work-pieces are placed abreast at each end of the table, can be seen in Fig. 2. The job in this case involved the milling of a radius and a contour on the bottom profile of shotgun frames at an average rate of 106 parts per hour. In addition to being set up

Fig. 2. In addition to taking advantage of reciprocal milling, this setup mounts shotgun frames two abreast at each end of the table for a profiling operation.

Fig. 3. Four straddle cuts are made per pass across parallel stud faces on front-wheel spindles. With a duplicate setup on the opposite end of the table, 125 parts are milled each hour.

Fig. 4. Reciprocal, index, and progressive milling are combined in the setup shown here and in Fig. 5. Three slots are machined in the bottom of a housing on the left-hand end of the table.

Fig. 5. The housings are inverted on the right-hand end of the table, where three slots are milled in the top (see Fig. 4). At both positions the parts are indexed on a rotary table.

for the type of milling described, this machine is also equipped with a cam-roller attachment that controls the rise-and-fall movements of the spindle-carrier for achieving the necessary profile.

Basically, this unit consists of a roller mounted on the spindle-carrier and a cam attached to the fixture. As the table advances the work toward the cutter the spindle-carrier moves down until the roller contacts the cam. Hydraulic pressure maintains contact as the table completes its feed stroke.

This same reciprocal-abreast combination is used for the gang-milling job in Fig. 3. Four separate straddle cuts are made per pass to machine four pairs of parallel stud faces on front-wheel spindles. The operating cycle is simple: rapid advance, feed through a distance of 1 7/8 inches at a rate of 3 ipm, rapid return, then repeat for the setup at the opposite end of the table. Production averages 125 parts per hour.

Going a step further, the application shown in Figs. 4 and 5 illustrates the combined use of reciprocal, index, and progressive milling. The term index milling refers to the fact that rotary tables are used to position the clutch transmission housing for milling three slots at each station. Progressive milling indicates that the operations performed at each end of the machine table are not identical, but are sequential. Noting the workpieces displayed on the machine table, three slots are milled in the bottom of the transmission housing on the left-hand fixture, Fig. 4, and three more slots are milled in the top of the housing on the right-hand fixture, Fig. 5. The entire cycle for both is completed in slightly more than one minute. Hourly production averages 50 finished housings—a total of 300 slots.

° ° °

High-Speed Coil-Welding Line

United States Steel Corporation has begun operation of a new high-speed coil-welding line at the McDonald Mill of its Youngstown, Ohio, district works which will permit the production of steel coils weighing up to 30,000 pounds, or about four times the size of any previously produced there. The new heavy coil will allow fabricating plants to operate with considerably less down time for the changing of coils, in addition to providing a larger range of tailor-made steel products. Coils ranging from 5 to 38 inches in width and varying from 3/64 to 5/16 inch in thickness can be welded. An automatic oiling device also was installed to satisfy customer requirements for oiled strip products.

Paul B. Schubert

NEW MATERIALS

The properties and new applications of materials used in the mechanical industries

Corrosion-Resistant Bearing Steels with High Hot Hardness

A family of bearing steels which includes "Lesco BG 41, 42, and 43," exhibiting hot-hardness properties and resistance to wear, corrosion, and oxidation, has been announced by Latrobe Steel Co., Latrobe, Pa. The first member of the family has the following percentage composition: carbon, 1.05; silicon, 0.30; manganese, 0.50; chromium, 14.50; molybdenum, 4.0; and vanadium, 0.12. It has a hardness which ranges from 62 at 100 degrees F. to 51 at 1000 degrees F. on the Rockwell C scale. Its properties make it useful for applications in bearings and structural components in jets and missiles.

Lesco BG 42 and 43 have the same composition except that the carbon and vanadium contents have been changed to 1.15 and 1.00 per cent, respectively, in the case of BG 42, and to 1.20 and 2.00 per cent, respectively, in the case of BG 43. The 42 and 43 formulations have a hardness which ranges from 64 at 100 degrees F. to 54 at 1000 degrees F. on the Rockwell C hardness scale.

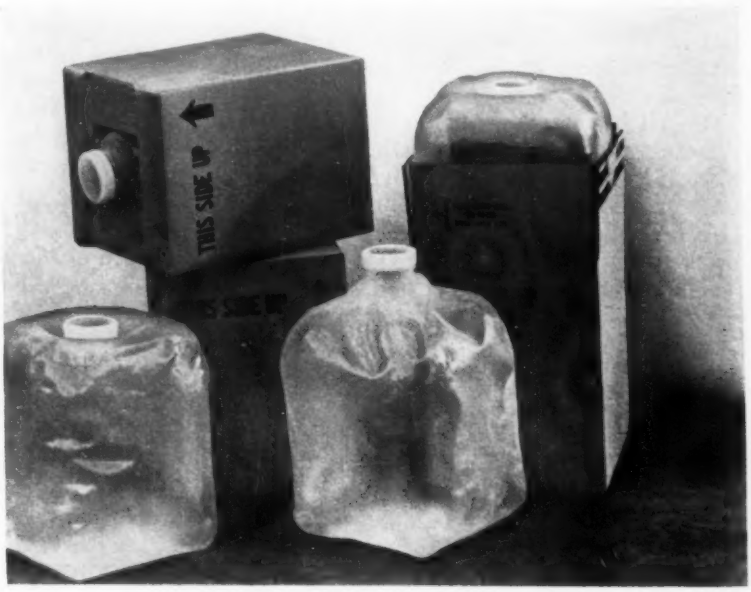
Circle 565 on Readers' Service Card

Precolored and Oversize Precision-Ground Flat Stock Available

The addition of a precolored and oversize line of "Milford" oil-hardening precision-ground flat stock has been announced by Henry G. Thompson & Son Co., New Haven, Conn. Manufactured from a fine-grained electric-furnace steel, this oil-hardening ground flat stock is supplied precolored to a deep blue-black—ready for immediate scribing or layout work.

The precoloring process does not affect heat-treating qualities or change the size of the stock. It also assists in preventing rust. The stock is supplied in 18- and 36-inch lengths, in a complete range of standard sizes.

Oversize material is used in making tools and



Liquids of virtually all kinds can be transported and stored in these shatterproof, corrosion-resistant, 5-gallon, collapsible polyethylene plastic jugs called Flex-O-Boys, which are extrusion blow-molded by Associated Plastics, Inc., Cleveland, Ohio. When empty, these containers take up one-third the space requirement of non-collapsible containers.

Circle 566 on Readers' Service Card

parts where it is necessary to do finish work on the stock after forming and heat-treatment and still produce a tool having a final dimension corresponding to the fractional catalogue size.

Circle 567 on Readers' Service Card

Stainless-Steel Automatic Welding Wires for Submerged-Arc Process

Stainless-steel welding wires for use with 308, 309, 310, 347, and 502 stainless steel in submerged-arc welding are now being marketed by Air Reduction Sales Co., a division of Air Reduction Co., Inc., New York City. These wires conform to the AWS and ASTM standards for corrosion-resisting and chromium-nickel steels. These standards provide close control of the amount of ferrite in the weld deposit. Lack of ferrite can result in weld cracking, while excess ferrite reduces the mechanical properties of the weld.

Available in 25- and 50-pound weights, each coil is carefully thread-wound to facilitate unwinding, and a constant controlled tension is maintained during coiling to assure a neat coil that will support itself and keep its designed shape and dimensions.

Circle 568 on Readers' Service Card

Cemented Tungsten Carbides that Are Shock and Wear Resistant

The Allegheny Ludlum Steel Corporation's Carmet Division, Pittsburgh, Pa., has developed a family of cemented tungsten carbides that are said to extend tool life up to 200 per cent. These grades are called CA-704, CA-711, and CA-720 and can handle jobs ranging from fine finishing and precision boring to heavy and interrupted cutting. They combine edge wear and crater resistance and can endure both mechanical and thermal shock.

CA-704 has the hard, dense qualities needed in finishing cuts and precision boring. CA-711 has proved ideal for medium-to-finish cuts in general-purpose categories, and CA-720 brings to carbide tools a toughness and thermal shock resistance for such jobs as medium and very heavy work, including interrupted cutting on even the hardest steel alloys. Use of these carbides in job shops lessens the need for keeping a large variety of cutting tools in inventory.

Circle 569 on Readers' Service Card

Liquid Nitriding Process for Upgrading Steels and Cast Irons

A liquid nitriding process, known as Tufftride, which develops a tough, ductile, wear-resistant surface and increases fatigue strength of various steels and cast irons without forming a brittle white layer has been announced by Kolene Corporation, Detroit, Mich.

The process is being applied to low-carbon, alloy, stainless, tool, and heat-resistant steels, as well as gray, alloy, nodular or ductile, malleable, and pearlitic irons. Treated parts, besides having tough, non-brittle, wear-resistant surfaces, have good antigalling and antiseizing properties even when run without lubrication. Distortion and growth after Tufftriding of finished and ground parts is negligible, if there are no residual stresses prior to treating.

Fatigue life of the metal is appreciably increased: on low carbon steels, up to 80 per cent; medium-carbon steels, 60 per cent; 18-8 type stainless steels, 35 per cent; gray cast iron, 20 per cent; and malleable iron, 43 per cent.

These improvements in fatigue life suggest the substitution of lower-cost materials; a redesign for weight savings; or the elimination of fatigue failures on parts currently in production, such as ball joints, gears, thrust washers, steering components, crankshafts, and many others.

Circle 570 on Readers' Service Card

Ready-to-Use Magnetic-Particle Inspection Materials

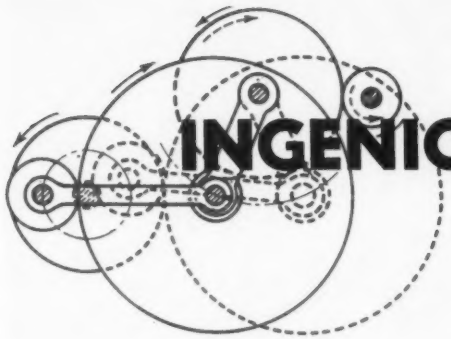
The availability of magnetic-particle inspection materials in pressurized spray cans and plastic squeeze bottles has been announced by Magnaflux Corporation, Chicago, Ill. The use of these items—called No. 14M fluorescent Magnaglo bath, No. 9BM Magnaflux bath, and No. 1 Gray Powder—facilitates the field testing of parts of complex shape on large wet type Magnaflux units. The sealed dispensers in which these products come also keep out dust, moisture, and other contaminants during storage. Their use also eliminates the need for bulky containers and the problems of mixing to formula or filling application devices which, in turn, reduces setup time to inspect complex parts.

Circle 571 on Readers' Service Card

Burnishing Compound for Holding Color While Barrel-Finishing Zinc

A burnishing compound devised to hold color in barrel-finishing zinc die castings has been announced by Minnesota Mining & Mfg. Co., St. Paul, Minn. Honite One-Twenty-Six finishing compound, as it is called, is a free-flowing soap type powder that can frequently be used in small amounts in the cut-down cycle. Then, without rinsing the load, more compound can be added for the burnishing cycle.

Circle 572 on Readers' Service Card



INGENIOUS MECHANISMS

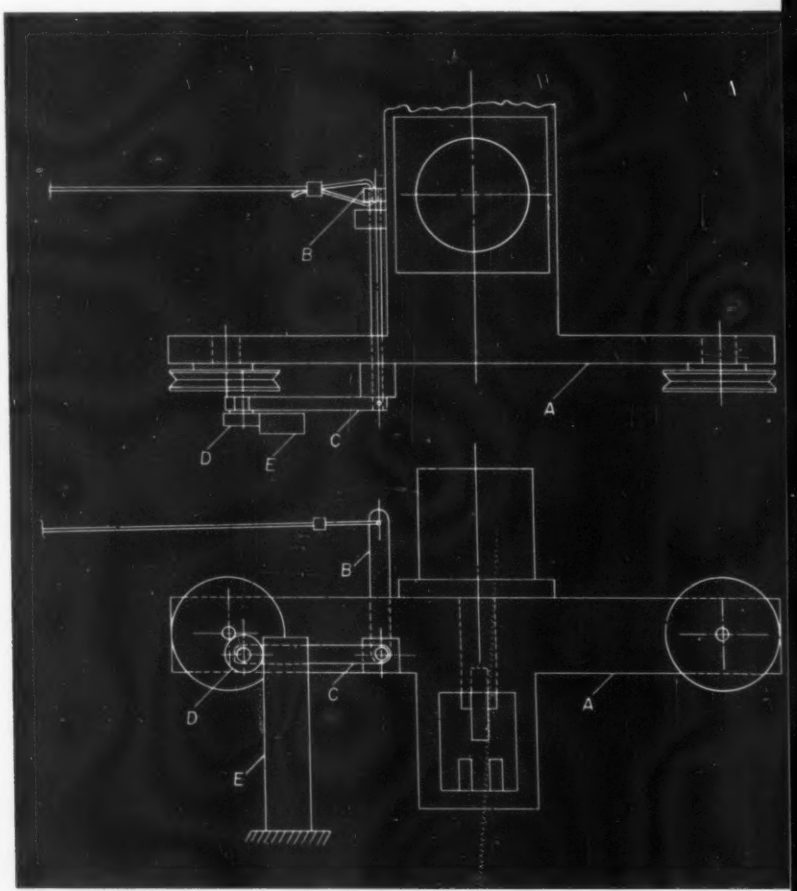
Mechanisms selected by experienced machine designers as typical examples applicable in the construction of automatic machines and other devices

Device Reduces Initial Acceleration of Flying Shear

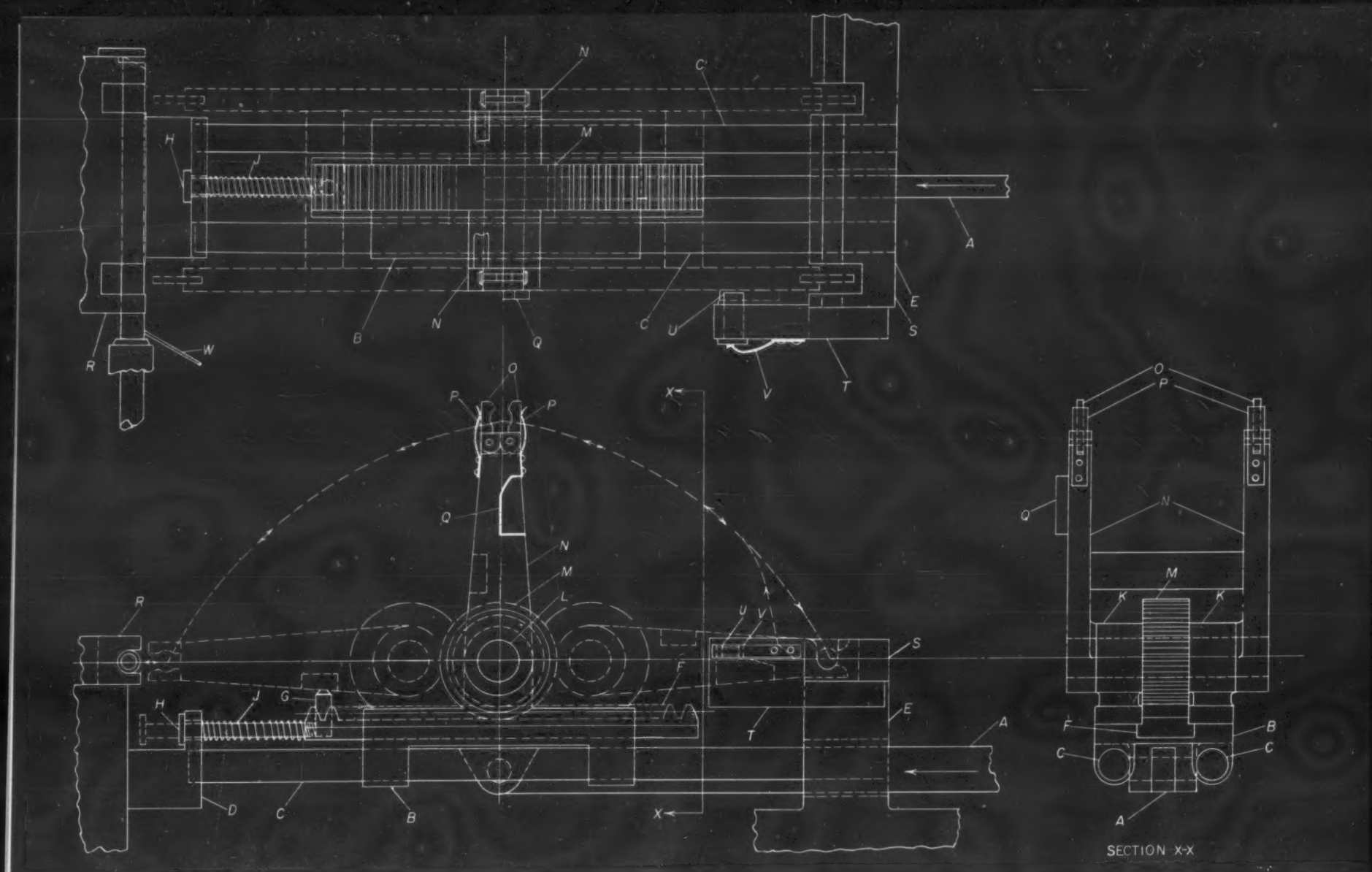
HUGH M. FOSTER, Riverside, Calif.

A device designed to reduce the force necessary to set a flying shear in motion is here described. In practice, flying shears employed on cold-roll forming machines may be actuated by any of several methods. One arrangement that results in accurate cutting-to-length of the roll-formed sections allows the shearing mechanism to be started and pulled by the rolled strip. In many cases, however, the strip does not have sufficient stiffness to overcome the inertia of the shear without buckling. By permitting acceleration to occur over a longer period, the mechanism shown in the illustration decreases the initial force required to bring the shear up to the speed of the strip and, thereby, reduces the tendency of the strip to buckle.

The mechanism is arranged as follows: A light flag, or lever, mounted on a track at the outgoing end of the strip runout table, is connected to the flying shear *A* by a cable to a hinged lever *B*. This lever, in turn, is attached to a second lever *C*. As the roll-formed section starts the flag moving, a roller *D*, mounted on lever *C*, pushes against a bar *E* attached to the machine base. This setup will gradually accelerate the shear carriage, which is mounted on rollers or on machine ways. The shearing mechanism is pneumatically or hy-



Device that reduces the initial force necessary to accelerate a flying shear. When lever (B) reaches a horizontal position the shear (A) and the strip are moving at the same speed.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draulically operated to sever the rolled strip.

When lever *C* reaches the vertical position, it comes into contact with a stop and the roller leaves bar *E*. The shear carriage has then been accelerated to the same speed as the moving strip and is being pulled by it. At this point, the shearing mechanism is immediately actuated by a micro switch and the flag is triggered, releasing it from the end of the strip. A spring returns the shear to the starting position and the cycle is repeated. Lengths of the lever arms may be varied to suit the acceleration required.

Transfer Device for Cylindrical Parts

L. KASPER, Philadelphia, Pa.

Transfer of cylindrical parts from one work station to another can be accomplished by the arrangement seen in the accompanying illustration. In the particular application shown, a collet-feeding setup introduces the work into the first station in the form of tubing. After the tubing is cut to length at the required angle by a slitting saw, the resulting work-piece is picked up by transfer arms which rotate 180 degrees and deposit it at the second station. A cam-operated drive activates the mechanism.

The transfer mechanism is illustrated at the mid-point of its cycle. Drive-bar *A*, which is given a variable reciprocating motion by a cam (not shown), transmits this movement to a slide-block *B* that slides on two rods *C*. These rods, in turn, are supported at the ends by members *D* and *E*. Slide-block *B* is grooved to accommodate a sliding rack *F*, which has a pin *G* and a headed stud *H* at one end. Stud *H* passes through a hole in a projection on member *D* and carries a spring *J*. This spring exerts pressure on the rack, thus tending to hold the head of the stud in contact with member *D*.

Bearings *K*, the bases of which retain the rack in block *B*, support a shaft *L*. Keyed to this shaft is a gear *M* that meshes with the rack. In addition, two transfer arms *N*, connected by a bar, are keyed in alignment on the shaft. Gripping jaws *O*, located on the end of each arm, are held in the closed position by springs *P*. One of the transfer arms carries a small block *Q*.

Member *R* is grooved to guide and back up the entering tubing, and a receiving block *S*, mounted on member *E*, is grooved on the top to accept the severed piece of tubing. Another block *T*, also mounted on member *E*, carries a latch-pin *U*, which is held under tension by a spring *V*.

In operation, drive-bar *A* moves to the left from the center position, carrying slide-block *B*. Since gear *M* is supported on block *B*, and rack *F* cannot move with it due to the resistance of spring *J*, gear *M* is caused to rotate counterclockwise in mesh with rack *F*. Thus, movement continues until the bar connecting the transfer arms *N* contacts pin *G*, as shown in the phantom view of the arms at the left. Pin *G* is so adjusted that arms *N* are then in the horizontal position. At this point in the cycle, there can be no relative motion between block *B* and rack *F*.

Continued movement of block *B* causes spring *J* to compress and the entire assembly to move as a unit farther to the left until the gripper jaws are forced over the tube and it is held under the tension of springs *P*. The driving cam then provides a rest period while the saw *W* cuts the required length from the tubing.

After the saw has completed its operation, bar *A* is reversed and the transfer arms *N* withdraw the work-piece horizontally from guide block *R*. This movement continues until the head of stud *H* again contacts member *D*, at which time rack *F* can no longer move to the right. But as block *B* moves farther in the same direction gear *M* rotates clockwise in mesh with rack *F* until the transfer arms have revolved 180 degrees and deposited the tube in the groove in block S. After the transfer arms reach the horizontal position, latch-pin *U* engages the upper side of block *Q*.

The cam then reverses drive-bar *A*, causing the section of tubing to be stripped from between the gripper jaws *O*. This movement of the transfer arms takes place horizontally because they are held in this plane by latch *U*. When the necessary horizontal travel has been completed, block *Q* has moved so that it is no longer under the latch-pin. During this motion, spring *J* is compressed by rack *F*, and in order to prevent sudden expansion of the spring, the upper edge of block *Q* can be shaped to permit a more gradual return. The transfer arms then rotate back to the central position and the cycle is repeated. A plunger (not shown) removes the part from block S.

A mechanism for transferring cylindrical parts from one workstation to another. Drive-bar (A) is given a variable reciprocating motion by a cam.

TOOL ENGINEERING *Ideas*

Tools and fixtures of unusual design and time- and labor-saving methods that have been found useful by men engaged in tool design and shop work

Handy Fixture Clamps Effective with Simple Shapes

FEDERICO STRASSER, Santiago, Chile

Fast, positive action is the keynote of two clamping devices, with a fixture (Fig. 1) holding two rectangular sections at once, and a jig (Fig. 2) arranged to permit drilling both legs of an angle section accurately.

The milling fixture clamp (Fig. 1) holds two parts at once, with pressure to the right distributed by equalizer shoe *E*, and downward from the simple knurled set-screw S on the lever *L*.

Angles are held for drilling operations on either leg of right-angle stock, using the box jig in Fig. 2. When wrench *A* is tightened on finger strap *B*, pressure forces the work to the left and upward simultaneously. The work is held securely, and if end-stops are provided, work cannot be wrongly positioned.

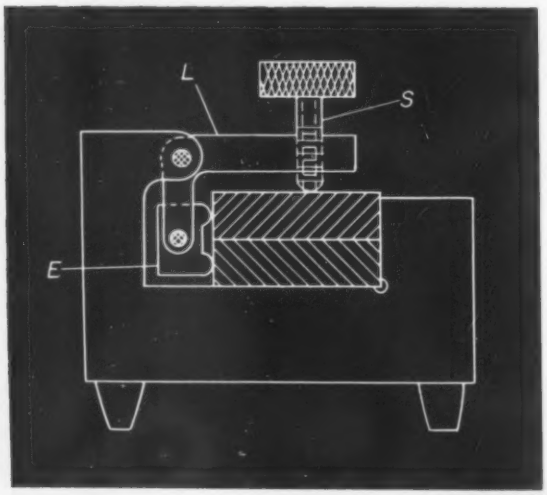


Fig. 1. (Above) Rectangular sections are clamped firmly in this milling fixture by two-way pressure exerted by screw (S) and lever (L).

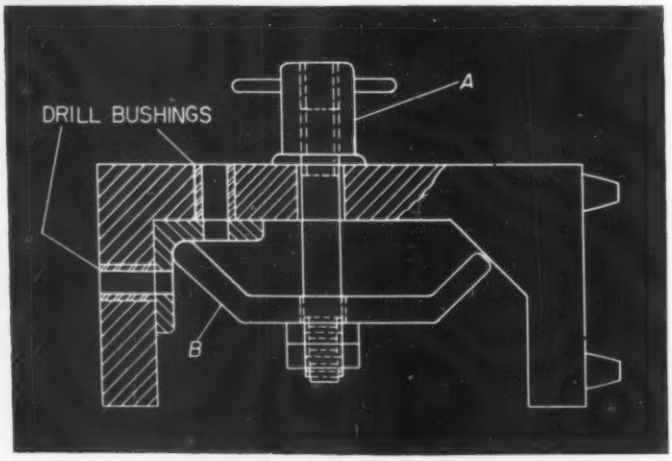


Fig. 2. (Right) Both legs of "angle iron" can be drilled in this economical, versatile box jig. Construction is so simple and inexpensive that they can be made in a variety of sizes and hole patterns for short, repetitive lots of work.

Multiple-Position Lathe Stops

JOSE C. SOBKOWIAK, Jackson, Mich.

Versatile, six-position lathe stops can be used either singly or in pairs. When used in pairs, as shown in Fig. 1, they will prove to be timesavers in turning parts having shoulders, recesses, or formed sections that are to be held within close limits. For this application, the unit at *A* is

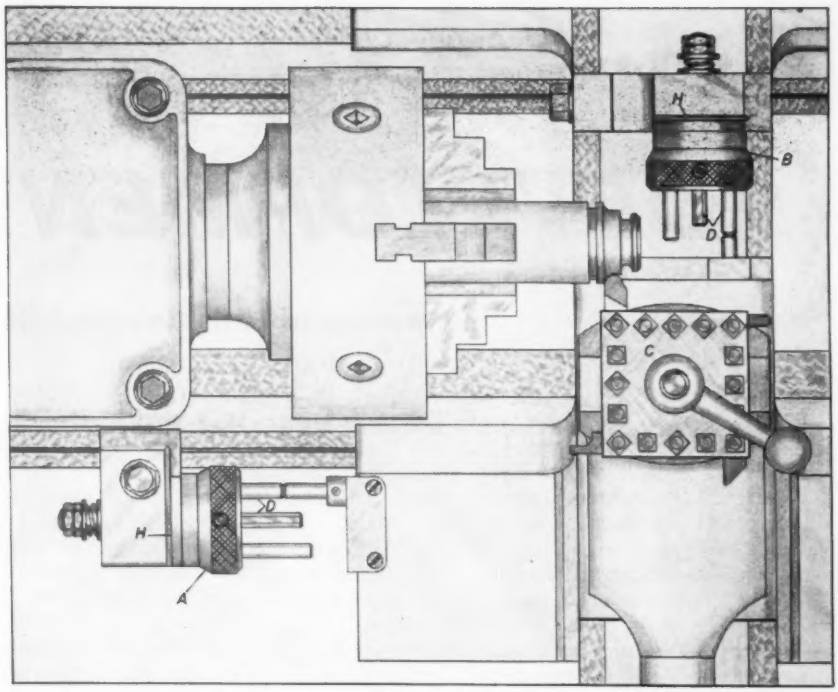


Fig. 1. (Right) Two six-position lathe stops, (A) and (B), are being used in conjunction with the four tools in holder (C) to turn a contour that might otherwise require the use of a specially ground form tool.

Fig. 2. (Below) Details of multiple-position lathe stop. View X shows the spacing of the six stop-pins (D) and method of mounting the assembly to the lathe bed. Spring-loaded plunger (G), View Y, retains stop-housing (E) in the selected position.

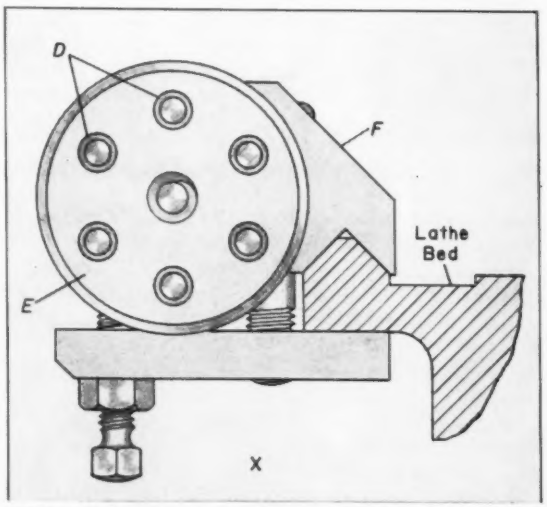
mounted on the lathe bed to serve as a carriage stop, and the unit at *B* is mounted on the carriage to serve as a cross-slide stop.

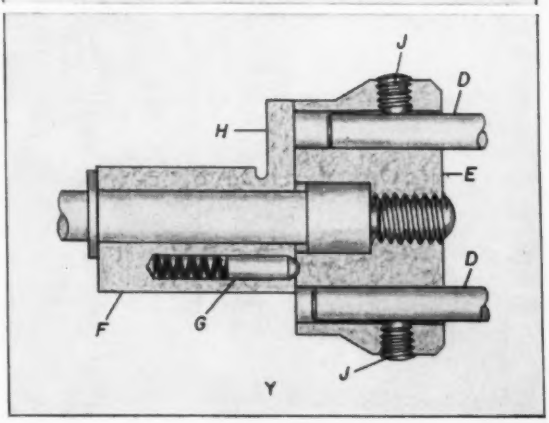
Many parts that would normally require the use of a form tool can be made by using one or more of four tool bits that are locked in tool-holder *C* and arranged to produce the required shape. The depth of cut would be controlled by stop *B* and the spacing by stop *A*.

Spacing of the six stop-pins *D* about the center of stop-housing *E* is shown in View X, Fig. 2. Also illustrated is the way stop-bracket *F* mounts to the lathe bed.

The outside of the stop-housing is knurled to facilitate manual indexing from one pin to the next. Proper positioning of each pin is assured by a spring-loaded plunger *G*, View Y. It is housed in the bracket and enters one of six recesses directly in line with each stop-pin.

During machine setup the stop-pins can be set by one of two methods—either by a micrometer with the unit installed on the lathe, or by a height gage and surface plate, which, of course, necessitates removal from the machine. Settings in either case are made from the exposed end of the pins to a measuring surface *H* provided on the bracket. After each pin is set, it is locked in place by a socket set-screw *J*, which binds against a flat area extending the length of the pin. By numbering the stop-pins on each unit 1 through 6, and by numbering the cutting tools 1 through 4, a simple chart can be made by the operator showing the indexing sequence for each cut.





NEW DEVELOPMENTS IN

Machine tools, unit mechanisms, machine parts, and

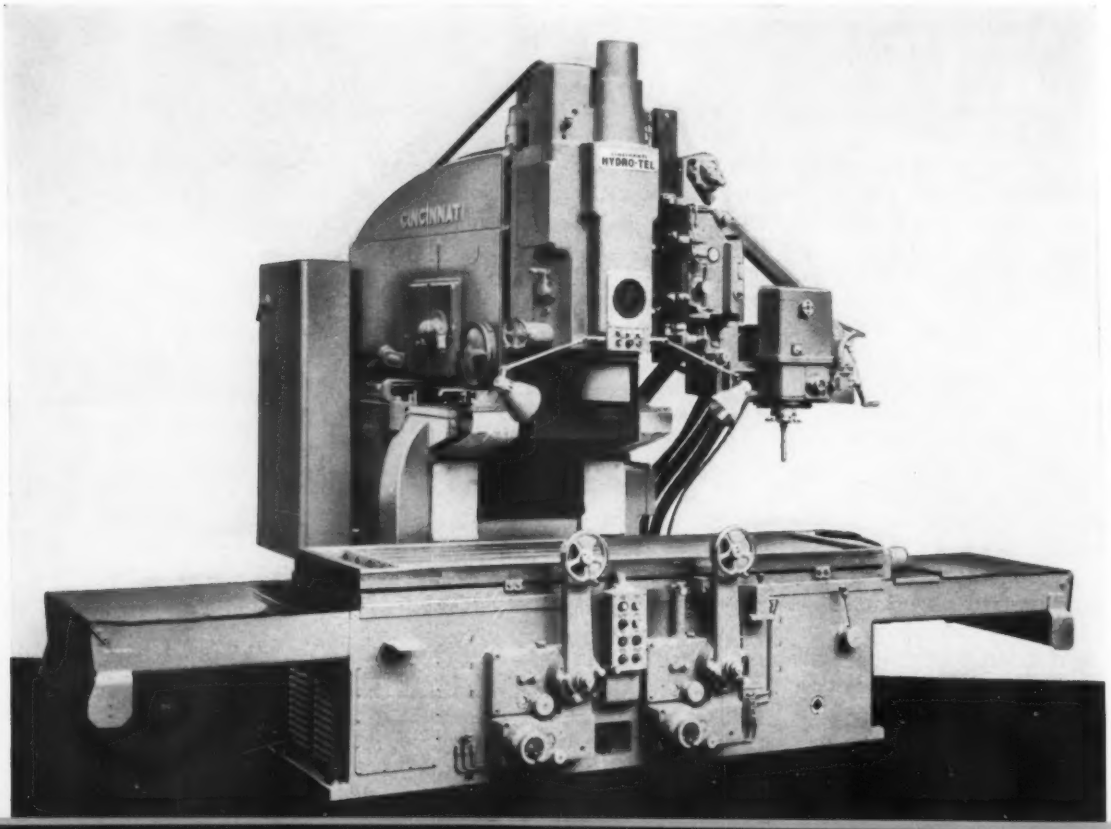
Cincinnati Vertical Hydro-Tel Milling Machine

A versatile 28-inch vertical Hydro-Tel milling machine, adaptable for general-purpose manually controlled milling, die-sinking, automatic profile-milling, and multiple-spindle production milling, has been announced by the Milling Machine Division, Cincinnati Milling Machine Co., Cincinnati, Ohio. This machine has a new cross-slide and vertical head, with horsepower ratings 50 to 100 per cent greater than preceding models. All hand and power feeds are hydraulically actuated to provide effortless manual traverse of slides and smooth, infinitely variable feeds. Table and cross-slide levers have five positions for engaging feed and rapid traverse in either direction. The table, cross-slide, and vertical-head feeding rates can be engaged either separately or together.

Slide-ways and all critical bearings are automatically lubricated to assure long life and instant feed response. Vertical-head ways are hardened and ground as a further aid to long life and smooth vertical feed when depth tracing. To facilitate service, hydraulic oil is contained within a removable tank on which the pumps are mounted.

Table and cross-slide feeds are infinitely variable from 1 to 25 ipm or 1/2 to 12 1/2 ipm; vertical-head feeds range from 1 to 15 ipm. There are sixteen spindle speeds, six optional ranges for the 10- and 15-hp drives, and four for the 20-hp drive. The spindle

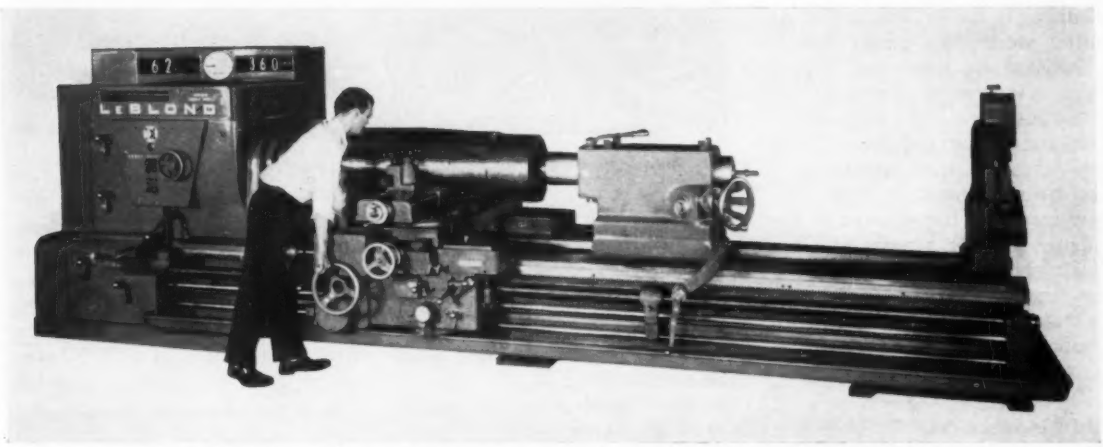
Vertical Hydro-Tel milling machine, with 60-inch table traverse, equipped for automatic die-sinking



Edited by Freeman C. Duston

SHOP EQUIPMENT

material-handling appliances recently introduced



LeBlond heavy-duty model lathe equipped with new Servo-Shift speed-control unit

nose conforms to Cincinnati's Arbor-Loc design, and spindle-lock and spindle-jog features facilitate quick changing of cutters.

The new Hydro-Tels may be equipped with automatic depth control for die-sinking; 360-degree automatic profiling, with or without conventional manual control; combination automatic depth control and 360-degree profiling; automatic die-sinking cycles with pick feed; and for many other types of work, using a wide range of attachments and accessories.

Circle 579 on Readers' Service Card

LeBlond "Servo-Shift" Eliminates Manual Gear Shifting on Heavy Lathes

A speed-control unit, named Servo-Shift, which eliminates manual gear shifting is a new development of the R. K. LeBlond Machine Tool Co., Cincinnati, Ohio. This unit has been applied to the LeBlond NK design heavy-duty lathes and will soon be made available on other heavy-duty models. In addition to Servo-Shift, these lathes can also be equipped with remote apron control and digital read-out.

Using the Servo-Shift only, the operator sets a dial on the headstock for the cutting speed opposite work-piece diameter and presses the shift button. The lathe automatically shifts gears and runs at the spindle revolutions per minute which produce the selected feet-per-minute speed. If he chooses, the operator can select spindle revolutions per minute instead of feet per minute.

While making a pass on one diameter of the work-piece, feet per minute or revolutions per minute can be preselected for another diameter. When the tool is moved to the new diameter, all the operator has to do to maintain a correct speed is to press the shift button.

When using the Servo-Shift with remote apron control, operation of a LeBlond Servo-Shift lathe can be further simplified by the addition of a control station at the lathe apron. This station, with a large drum dial, provides shift control and feet-per-minute and revolutions-per-minute selection. Apron control on these long-bed lathes eliminates time-wasting trips to headstock controls.

If the lathe is fully equipped with Servo-Shift with remote apron control and digital read-out, an option available only with the remote apron control, the operator never has to guess when a change in revolutions per minute is needed because an illuminated indicator is mounted above the headstock and shows the exact feet per minute and revolutions per minute being used at all times.

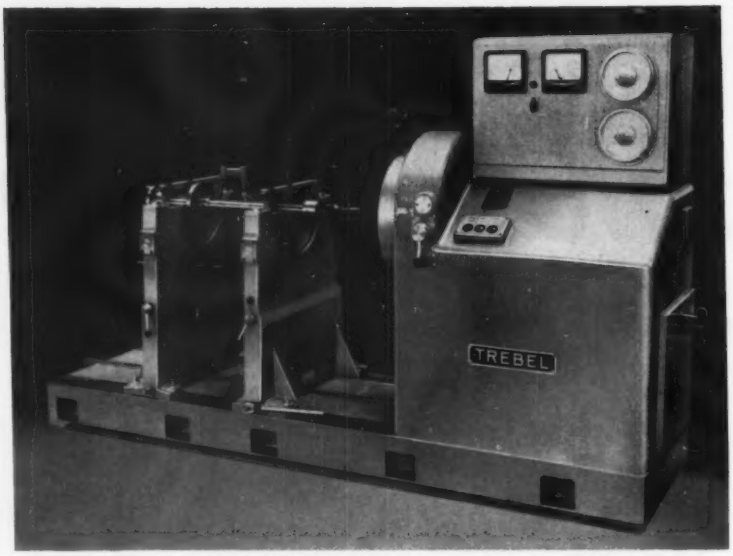
Circle 580 on Readers' Service Card

Trebel Automatic Balancing Machine

A newly designed force-measuring balancing machine, which automatically indicates the amount of unbalance in a work-piece and the exact angular location without the need of trial calibration runs or test weights, has been introduced by the American Trebel Division of Kurt Orban Co., Inc., Greenwich, Conn. By supporting the work on rigid bearings, actual operating conditions of the rotating element are simulated on this Trebel Model F balancer. The centrifugal forces which the rotating work-piece exerts due to unbalance are measured directly by a new type of pressure-sensitive transducer. Thus the need for first converting unbalance force into vibration, then measuring it, has been eliminated. With this new machine, the amount of unbalance and its location are immediately indicated. Indication of the amount is in ounces at any preselected correction radius. Both amount and angle readings refer to any two chosen planes.

The machine may be operated by relatively unskilled personnel. With no setup calibrations required, the operator can shift from one type of work-piece to another without the need of calibration charts or a setup man.

An optional automatic programmer will run the machine through its entire measuring cycle at the push of the starter button. Left-and-right amount readings, as well as left-and-right angle readings, remain recorded until the next cycle is begun. Suitable for both production and piecework application, the programmer makes possible semiautomatic balancing operations on piecework. This feature offers completely new possibilities where limited quantities of different-size work-pieces are to be balanced.



Automatic balancing machine introduced by the Kurt Orban Co., Inc.

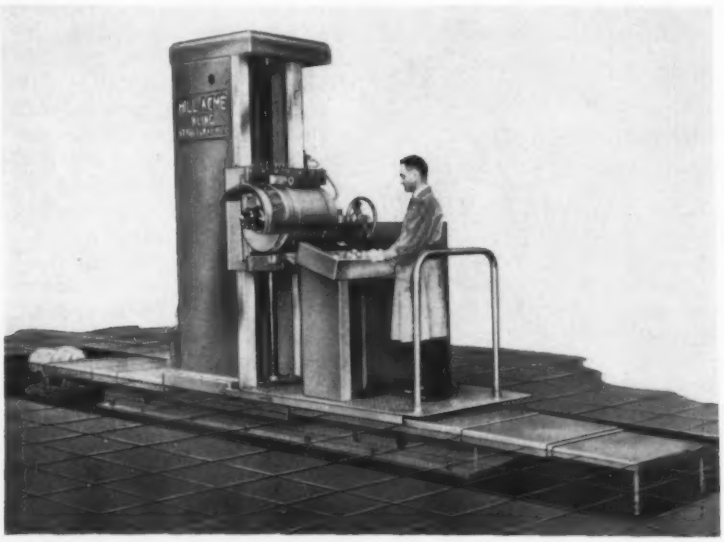
Circle 581 on Readers' Service Card

Hill Acme Redesigned "Kling" Structural Mill

The Kling structural mill, developed for end milling of structural shapes, has been completely redesigned by the Hill Acme Co., Cleveland, Ohio, which now manufactures and sells the entire Kling line of metalworking tools. The new structural-mill design is said to insure faster stock removal and more rapid positioning of the working head.

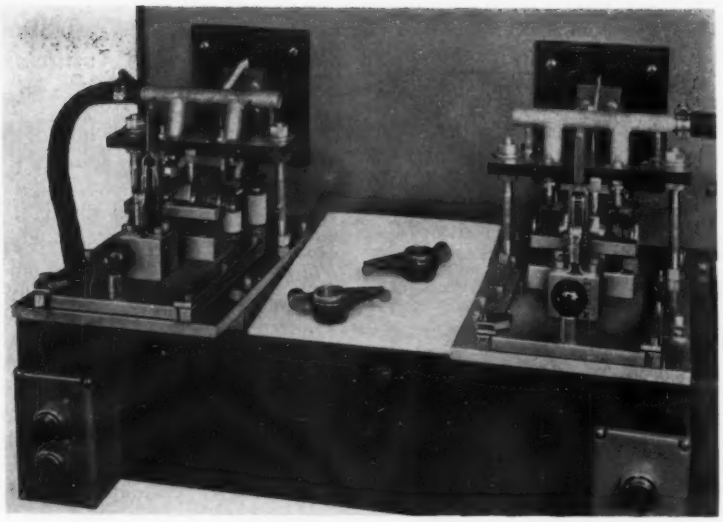
New design features incorporate ball-screw lead-screws, nonmetallic precision-ground ways, hydraulic counterbalance of the working head, electronic overload protection, hydraulic binders, centralized automatic pressure lubrication, and welded steel type of construction.

This machine now weighs 18,250 pounds, and has a horizontal travel of 120 inches with a vertical travel of 60 inches. The 40-hp direct-drive spindle motor affords 10 inches of infeed. Either 4 1/2- or 5-inch diameter cutters, with carbide inserts, will feed 30 ipm with a 1 1/2-hp motor of 60 ipm with a 3-hp motor.



Redesigned Kling structural mill now being built by the Hill Acme Co.

Circle 582 on Readers' Service Card



Ther-Monic equipment built by Induction Heating Corporation for a supplier of automotive components

Manually Operated Equipment Hardens Rocker Arms

Induction Heating Corporation, Brooklyn, N. Y., has had considerable experience in such jobs as the hardening of rocker arms, and has built fully automated equipment for most of the major automotive manufacturers who produce truck, tractor, marine, and industrial engines. Generally, such equipment must be integrated into existing production lines, and generally, too, such lines are designed for the absolute minimum in manual labor.

However, several of the larger-volume auto makers "farm out" such jobs. The handling equipment at the supplier plants need not, of course, be as sophisticated as that employed in the large plants of the leading automobile manufacturers. The following "case history" is typical of such applications in which Induction Heating Corporation's Ther-Monic equipment is used which can easily be adapted for other hardening, brazing, and annealing jobs.

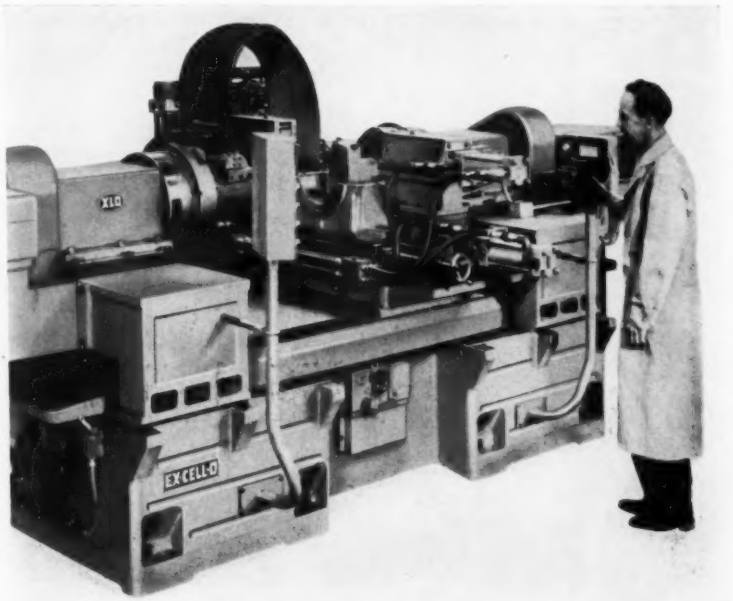
The particular job cited involves manual loading and unloading. The operator simply places two rocker arms on each side of a spindle, clamps the parts in place, then slides the tray forward into the work coil area and starts the cycle by depressing the start button on the loaded side. Then he proceeds to load the alternate side. (Even if the heat and quench cycles have not been completed on the loaded side, he may press the start cycle for the second side.) To insure that each station performs on schedule, a memory circuit incorporated in the control circuit takes over and starts the cycle the instant the heat cycle of the alternate side is completed.

The fixture can be adjusted to handle six different rocker arms—three "rights" and three "lefts." Heating time for the rocker arms (quench time included) is about ten seconds. It should be noted that the quench time is incidental, not added to the total time—and that the quench itself serves as a draw on the part and prevents cracking. Production for the setup itself, therefore, is two rocker arms hardened in seven seconds.

Circle 583 on Readers' Service Card

Precision Boring Machine with Versatile Fixture Equipment

Some forty-seven different sizes and configurations of heavy-duty pillow blocks are accommodated in the versatile fixturing on a Model 772 precision boring machine recently built by the Ex-Cell-O Corporation, Detroit, Mich. By engineering multiple operations in this manner, machining costs are said to have been sharply reduced over the costs of the previous method of using several machines on individual operations. It is also claimed that handling time and the resultant fatigue involved have both been drastically reduced by the use of this equip-



Ex-Cell-O precision boring machine with versatile fixture equipment

ment. Even more important, product accuracy is improved.

Two standard Ex-Cell-O heavy-duty precision spindles carry a minimum number of interchangeable boring quills. One common fixture base accommodates several easily changed subfixtures. The clamping arrangement is merely adjusted for each run of different parts.

In operation the bottom half of a pillow block is loaded, and the machine table is traversed to the left, where the top section of the pillow block is clamped into position. Boring then commences. A reversal of the order of these preliminary operations permits the machining of the other end of the pillow block.

Circle 584 on Readers' Service Card

Roto-Matic Gear-Tooth Deburring Machines

Two models of Roto-Matic deburring machines designed to remove the burrs from both ends of gear teeth simultaneously in one revolution of the work are being built by the Davis & Thompson Co., Milwaukee, Wis. Precise indexing of the gears on the spindle is not required and a friction type clamp is all that is needed to hold the gear in place while both of its sides are being deburred. While one revolution of the work is all that is normally required to deburr the average gear, the machine can be set for two or more revolutions, or an overrun of a certain number of teeth to meet special conditions. Housings over the grinding wheels serve as the intakes for the exhaust system and eliminate the necessity for completely enclosing the machine. This arrangement facilitates handling the work.

Model DB-20 with fixed table handles spur, helical, and worm gears, as well as sprockets. Model DB-30 has a tilt table which permits all types of gears to be deburred, including hypoid, bevel, and spiral types. Capacity range is from 4 to 24 inches in outside diameter up to 6 inches in face width 10 diametral pitch and larger. Steel, cast-iron, and bronze gears can be processed.

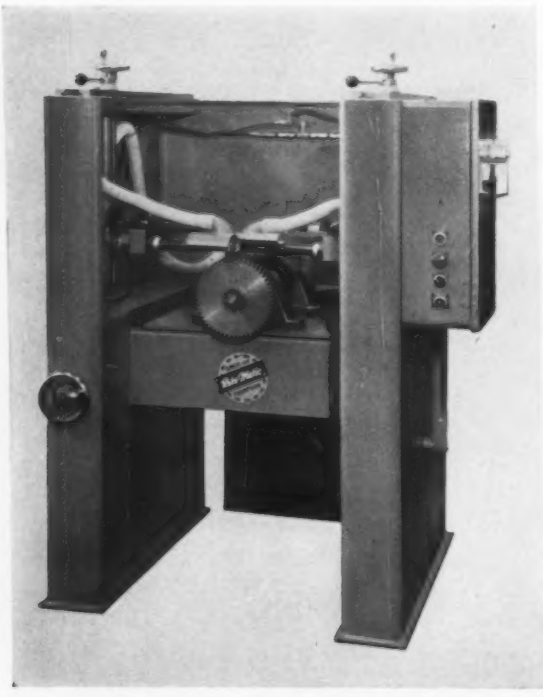
Circle 585 on Readers' Service Card

Three-Axis Tape-Controlled Turret Drill with Automatic Depth Control

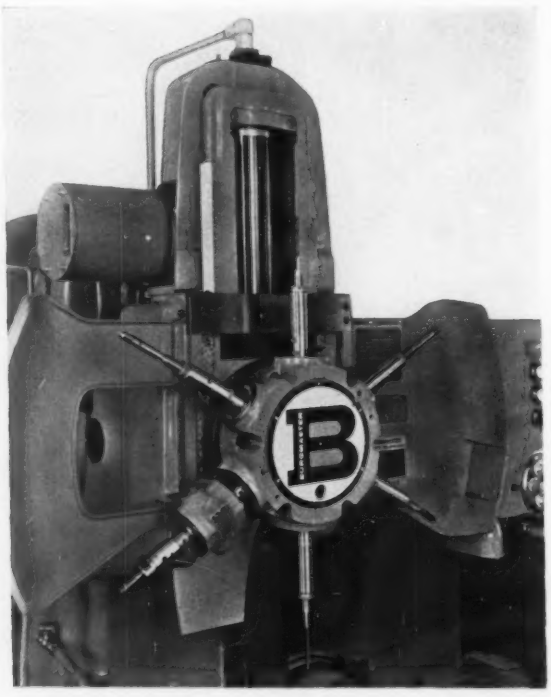
Automatic control by tape of the depth of cut of each spindle, the length of rapid traverse, and the selection of feeds and speeds is a new optional feature offered on all six- and eight-spindle tape-controlled turret drilling machines built by the Burg Tool Mfg. Co., Inc., Gardena, Calif. Three-axis tape-control systems are used to provide fully automatic machining with X-Y axis table positioning, and simultaneous Z-axis control of tool penetration to suit the individual operation of each spindle.

This new equipment is designed to facilitate setting up a job by eliminating manual presetting of mechanical depth stops furnished on the standard machine controls. By programming the rapid-approach length and depth of each cut into the punched tape, the same spindle can be used to machine holes of varying depths at different work positions.

The automatic depth-control feature must be ordered at the



Deburring machine developed by Davis & Thompson Co.



Burgmaster three-axis tape-controlled turret drill

time the machine is purchased and is offered in a wide selection of three-axis systems. These include General Electric, Hughes, Warner & Swasey, Westinghouse, Bendix, Rheem, Sperry, and Norden. In the particular machine illustrated, a G-E three-axis N/C is used which employs a selsyn box transducer and precision rack and pinion mounted on the hydraulic feed drum column to produce the feedback signal of the spindle position. Any spindle depth may be located within plus or minus 0.001 inch and is repeatable within plus or minus 0.0005 inch. The taped feed-rate selection provides a choice of one of ninety-nine feeds in a range of 1/4 to 50 ipm. Taped spindle-speed selection provides a choice of one of seven speeds at any spindle in three ranges—165 to 2400, 250 to 3600, and 375 to 4500 rpm.

Circle 586 on Readers' Service Card

Automated Two-Dimensional System for Milling Relief on Extrusion Dies

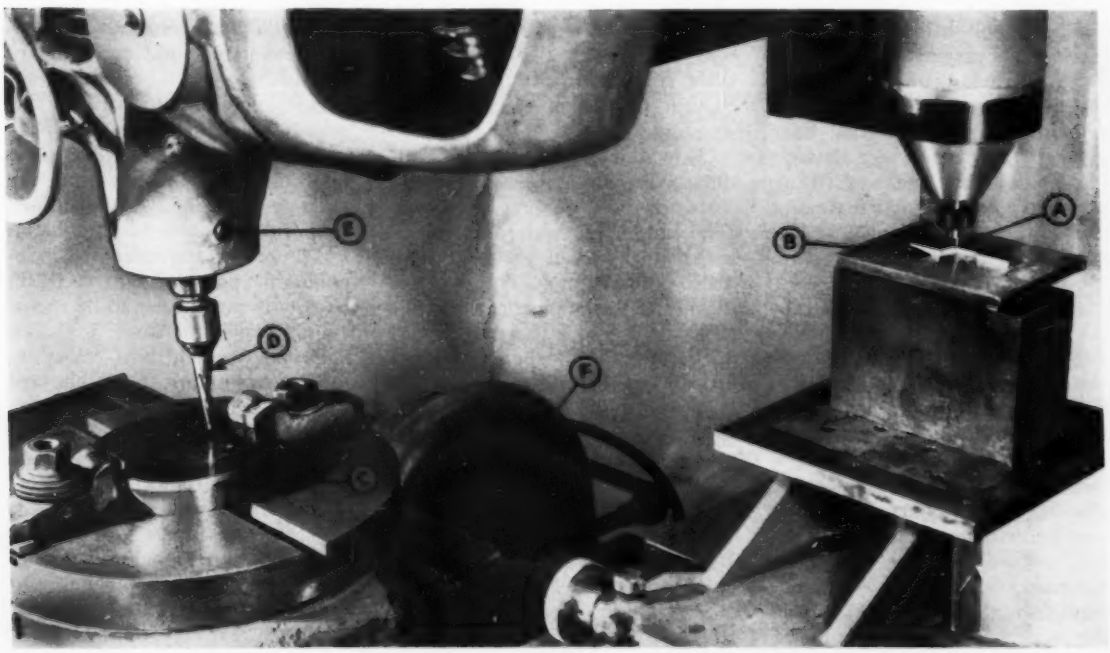
A system for automatic milling of reliefs on extrusion dies has been developed by the Electronics Division, Seneca Falls Machine Co., Seneca Falls, N. Y. Utilizing a standard milling head and a two-dimensional tracer control system, the unit permits constant feed-rate control and provides a fast, simple method of reproducing intricate designs for extrusion dies. The system can also be applied in some cases to milling the actual die opening. In this instance, end mills as small as 0.039 inch are used as the cutting tool.

The extremely small diameter of the sensing stylus—0.025 inch—enables the system to accurately follow very small designs. Tracing speed can be controlled over a 50-to-1 speed range. A typical range would be from 1 to 0.020 ipm. For years, extrusion dies have been cut manually, requiring considerable time and painstaking care. Application of the new two-dimensional tracer system is said to substantially reduce the time normally required for this operation and consistently produce work that is accurate within limits of plus or minus 0.003 inch.

The system is electromechanically controlled and operates from a template. It will follow any contour around a 360-degree path at a constant cutting speed, regardless of direction. The cutting speed can be varied manually or automatically controlled as a function of spindle speed to maintain a constant feed rate in inches per revolution of the spindle.

The two-dimensional tracer system incorporates a patented rotating eccentric-stylus design which has only one rotating shaft. All critical assemblies are eliminated and the need for adjustment is minimal. The stylus assembly, on contact with the template—which conforms with the design to be cut in the extrusion die—continuously feeds electric signals to X- and Y-axes servo drives. These low-powered signals are boosted to actuate a servo motor which controls table and cutting movements for any value of the X and Y coordinate axes.

The company's tracer system is comprised of four basic components: the stylus, the control panel, the control station, and the power drive. In manual control, the stylus permits an operator to move the tool in any desired direction, controlling each axis separately or both axes simultaneously. When



Seneca Falls automated two-dimensional system of milling relief on extrusion dies

the stylus contacts the assembly it will switch to automatic trace. All the electronic components used in this system are plug-in units. Referring to the typical set-up for milling reliefs on extrusion dies shown in the accompanying illustration, *A* is the stylus of sensing head; *B*, the tracer template—also used for gaging actual die opening; and *C*, the die blank. The tapered milling cutter is shown at *D*, standard milling head at *E*, and two-axis table at *F*.

The controls are designed for use with conventional machine tools and do not interfere with conventional operation. The control system can be purchased as a package unit and readily applied to most existing equipment.

Circle 587 on Readers' Service Card

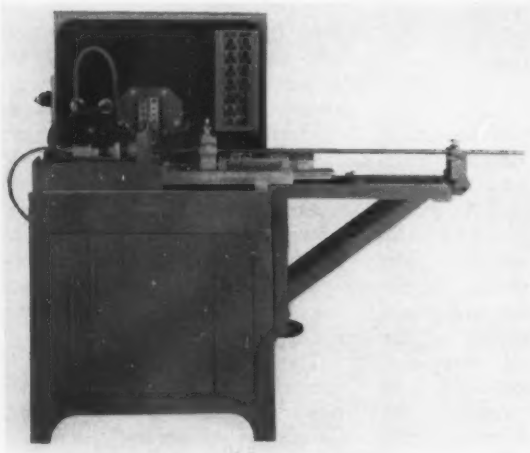
Leland-Gifford Knee Type Gun Drill

A knee type gun drill designed to facilitate drilling deep precision holes in ferrous or nonferrous materials, using carbide-tipped drills, is offered by the Leland-Gifford Co., Worcester, Mass. This machine is available with either a self-contained hydraulic feed or a lead-screw feed type of gun-drilling unit. A knee type set-up eliminates expensive fixturing when a variety of work is to be gun-drilled by coordinate elevating, traversing, and swiveling of the table.

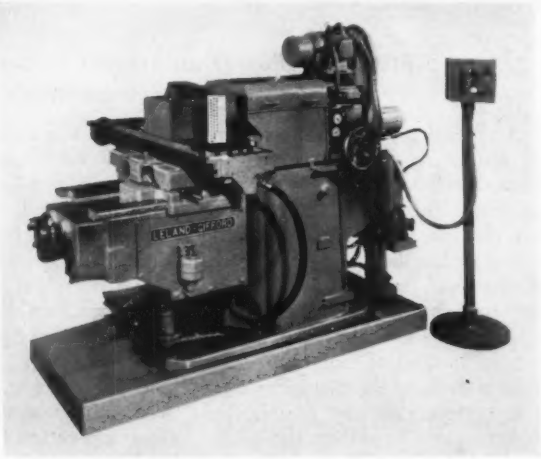
Recommended for drilling accurate holes up to 5/8 inch in diameter by 7 inches deep, the hydraulic feed unit offers the advantages of a highly uniform feed rate with simple feed-rate changing. Pump and spindle are independently powered with a 1 1/2-hp totally enclosed spindle motor which drives through a timing belt. For general use, variable-speed drives are available for speeds up to 10,000 rpm.

For holes having depths greater than 7 inches, the Leland-Gifford No. 24C electromechanical gun-drilling unit can be furnished with 12-, 24-, or 36-inch stroke. Driven by a 1 1/2-hp Dynabrake motor through a nonslip timing belt, the spindle can be run at speeds from 720 to 12,000 rpm with a 3600-

(*Continued on page 174*)



New fixturing built by Induction Heating Corporation for hardening torsion bars



Knee type deep-hole gun-drilling machine brought out by the Leland-Gifford Co.

Ther-Monic Equipment for Hardening Long Torsion-Bar Bearing Surfaces

The 5-inch bearing surface of torsion bars varying in length from 80 to 100 inches is hardened without distortion, while the bar itself remains within its original tolerance, by the use of a new technique employing unique fixturing supplied by the Induction Heating Corporation, Brooklyn, N. Y. The production rate is one bar hardened every five seconds.

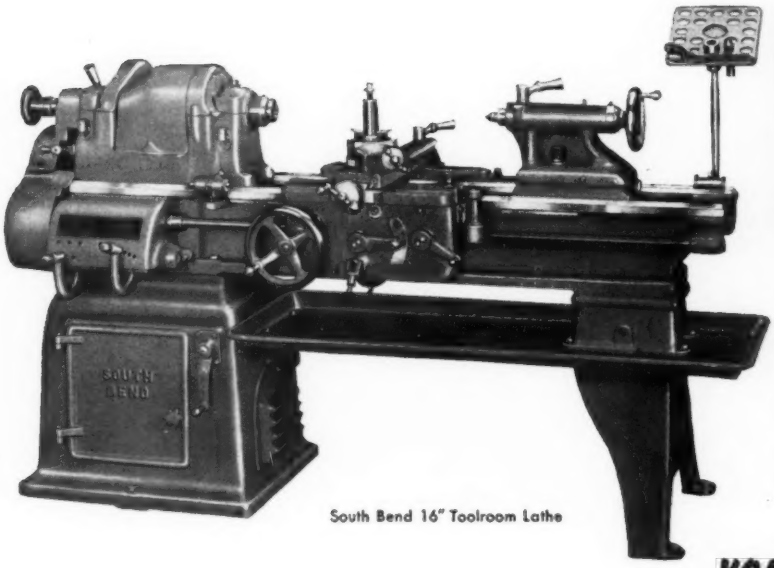
The torsion bars hardened by the new equipment are made of SAE 8660 steel, with a 7/8-inch outside diameter. This steel was chosen for its high "hardenability" and strength. When oil-quenched and drawn at 1000 degrees F., it has a yield strength of 132,000 pounds. Torsion bars, obviously, must be extremely tough and durable. Before they are induction-hardened, therefore, they are through-hardened in a furnace. The second step is the drawing of the bar from RC 63-65 to RC 47-50. The third operation straightens the torsion bar so that the axis is square with the surface within 0.005-inch true indicator reading.

Now the torsion bar is ready for the unique process devised for hardening the bearing area itself. The hardness required is RC 60 minimum, with a case depth of 0.045 to 0.060 inch. The operator simply loads the part in two ways. Two clamps lock the part on the fixture. (Note: If the part is not up against the end-stop, which is electrically tied in with the fixture controls, the fixture will not start. This was done so that the heat pattern will start and stop in the right area.) The 5-inch area is progressively scanned and followed by an oil quench at the rate of 1 inch per second. Due to the rapid heat and thin case, the torsion bar retains its original tolerance.

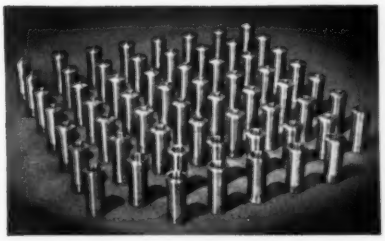
Circle 588 on Readers' Service Card

SAVE UP TO $350

on South Bend toolroom lathes with collets



South Bend 16" Toolroom Lathe



Take advantage of this unmatched offer . . . purchase any South Bend Precision Toolroom Lathe before May 1st and you will receive a set of South Bend Collets without extra charge. These are precision, milled thread, heat treated collets for round work.

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LATHE	PRICES START AT	COLLET CAPACITY, MAX.	COLLETS IN SET	SIZE RANGE by 64ths	VALUE of COLLETS
16" Toolroom	$3230	1 1/16"	61	1/16" to 1"	$350.75
14 1/2" Toolroom	2760	1 1/16"	61	1/16" to 1"	350.75
13" Toolroom	2358	1 1/16"	61	1/16" to 1"	350.75
10" Toolroom	1783	1 1/16"	61	1/16" to 1"	350.75
10" Toolroom	1590	1 1/16"	41	1/16" to 1 1/16"	196.80
10K Toolroom	815	5/8"	37	1/16" to 5/8"	173.90
9" Toolroom	726	1/2"	29	1/16" to 1/2"	130.50

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Chicago Pneumatic Tool eliminates rust, with Gulfcut® Heavy Duty Soluble Oil . . .

Previously, the Oil Tool Division of Chicago Pneumatic Tool Co. used chemical coolants in a variety of machining operations. But recently, this Fort Worth division switched to a heavy duty emulsifying cutting fluid—Gulfcut Heavy Duty Soluble Oil.

The reason: a rust problem that just wouldn't quit! "Any coolant tends to work into machine operating parts," says Donald Rial, General Foreman. "The trick is to use a coolant with effective anti-rust properties. Then, if the coolant does contaminate gearbox lubricating oil, the gears are protected against rust. Otherwise, an ugly layer of rust forms on tableways and in operating parts.

"However, we haven't had one bit of trouble since the changeover. Although we use a mixture ratio of one part oil to twenty parts water, the anti-rust inhibitor is so completely effective that rust has been eliminated, and yet the emulsion provides the neces-

Profile gage. Height is very critical. It's held to within .005 inches. Note the blanks at left—machined cones at right.

Kenneth Snyder, left, Plant Superintendent, shows Frank Mauro, Gulf Sales Engineer, Chicago Pneumatic's Jet bit. The company also makes Regular and Slant bits.

Grooving a cone for rock drill bit. The coolant: Gulfcut Heavy Duty Soluble Oil. Each cone is AISI 4815 steel. It takes 2½ minutes to groove one cone. Speed: 284 rpm. Feed: .0045 ipr.

improves tool life

GULF MAKES THINGS RUN BETTER!

sary cooling and lubrication for good tool life."

"We make and sell rock drill bits," says Kenneth Snyder, Plant Superintendent. "In this competitive business, we need every advantage to maintain an economic production rate. Gulfcut Heavy Duty Soluble Oil has helped improve tool life and reduce maintenance costs—and that's most important to us."

If you've got a machining problem, remember to try the Gulfcut line. You'll soon see how Gulf makes things run better! Call a Gulf Sales Engineer at your nearest Gulf office. Or write for detailed booklet.

GULF OIL CORPORATION
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GULF

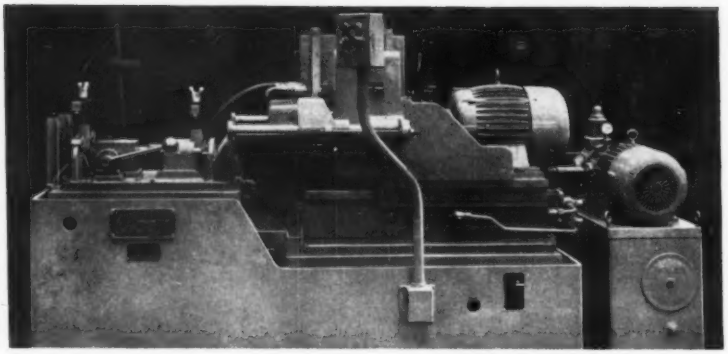
rpm motor, or at 360 to 6000 rpm with an 1800-rpm motor. Feed is actuated by and synchronized to the spindle speed and can be changed through pick-off gears from a minimum of 0.00019 ipr to a maximum of 0.0015 inch in increments of 0.000015 inch, if desired. A separate 1/2-hp Dynabrake motor powers the lead-screw for rapid approach, setup, and rapid return.

This gun-drilling equipment can be furnished as a complete machine, with base and hydraulic or lead-screw feed, with or without tooling for specific operations, or as drilling units only on a do-it-yourself basis. Also available is a high-pressure coolant system with an oil capacity of 100 gallons, capable of supplying a constant, closely controlled supply of clean oil under high pressure.

Circle 589 on Readers' Service Card

Machines Built to Drill Rear-Axle Tubes

The Avey Division, Motch & Merryweather Machinery Co., Cincinnati, Ohio, has recently shipped five special drilling machines of the type here illustrated to a European truck manufacturer. Each machine performs automatic drilling operations on a rear-axle tube assembly, utilizing a sixteen-spindle drill head mounted on a hydraulic-feed unit (Avey's No. 4 Hydroway). The vee type fixture is manually operated. All parts subject to wear are hardened and ground.



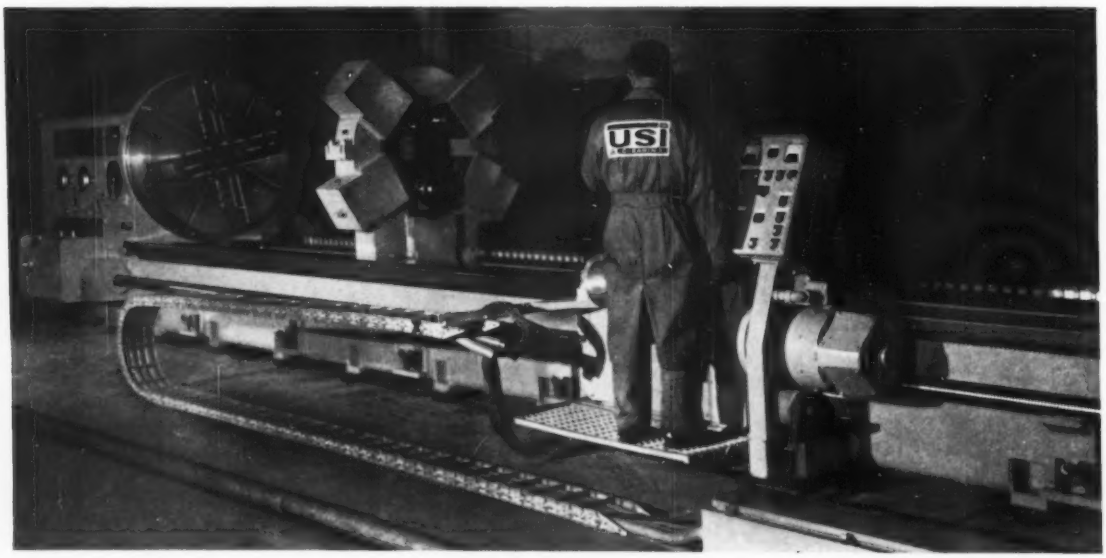
Avey drilling machine equipped to process rear-axle tubes

Circle 590 on Readers' Service Card

Huge Clearing-Axelson Heavy-Duty Lathes

A huge Clearing-Axelson lathe said to be one of the world's largest machines of its type has been built by the Clearing Division of U. S. Industries, Inc., Chicago, Ill., and will be shipped to the Homestead, Pa., plant of the United States Steel Corporation. This lathe can turn a part 40 inches in diameter. More than 66 feet in over-all length, it can turn a bar 50 feet long between centers. It is built entirely of welded steel and has been put together in two sections—each 30 feet long—to facilitate shipment either by truck or by rail. The manufacturer's modular design is employed so that the headstock and bed are independent members, unitized in such a way that the entire structure is claimed to be more rigid than if it were one piece. The drive, electrification, quick-change gear-box, and control console are also of a modular type construction—removable as a unit—serviced as a unit. An automatic lubrication system supplies the bed and carriage ways with the proper lubricant at all times.

(*Continued on page 178*)



Heavy-duty Clearing-Axelson lathe of exceptional size built for U. S. Steel Co.

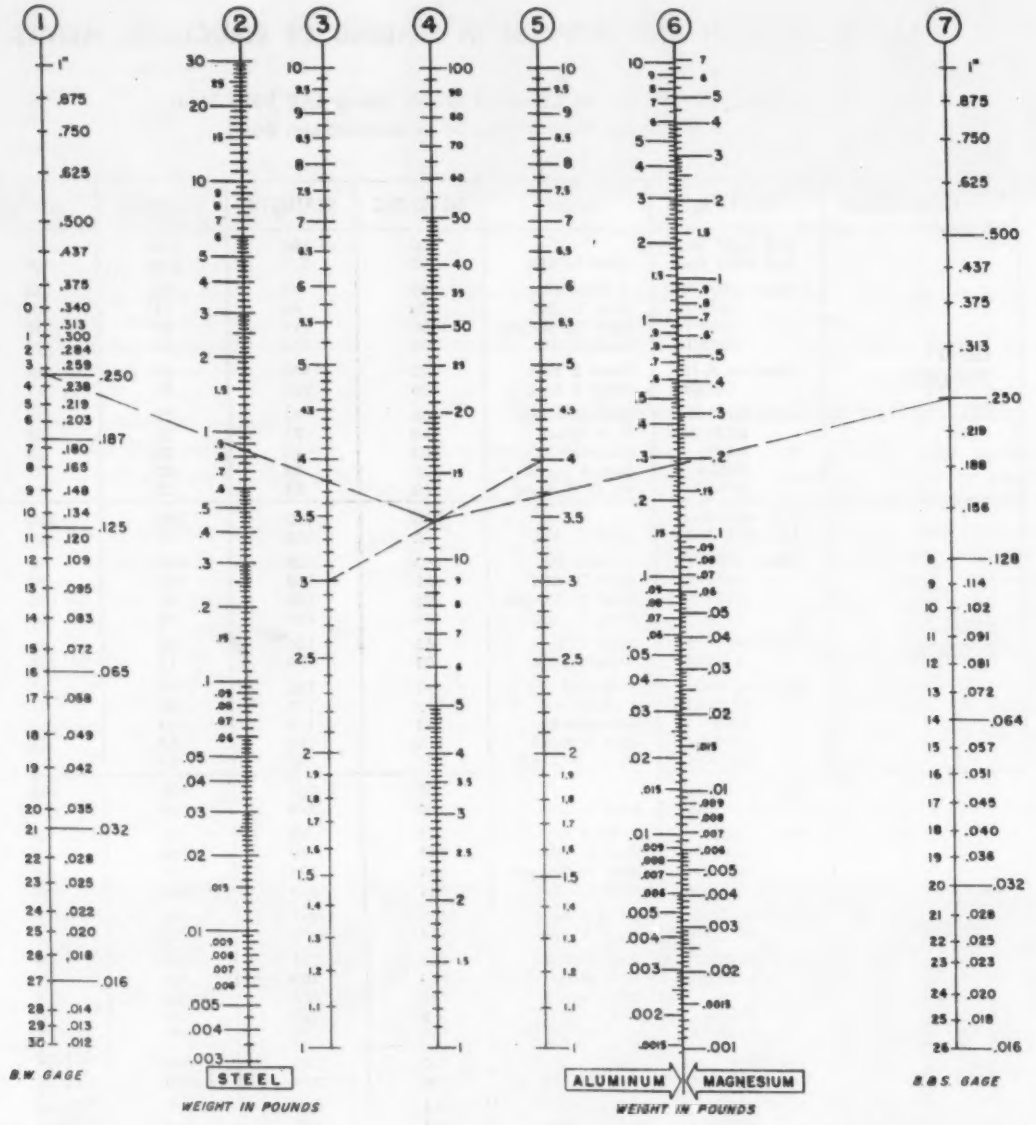
RELATIVE STRENGTH AND STIFFNESS IN BENDING OF STRUCTURAL METALS

Rectangular Beams of Constant Width Using SAE 1025 Steel and Minimum Yield Strengths as Comparison Basis

COMPARISON	MATERIAL	FORM	THICKNESS	STRENGTH	STIFFNESS	WEIGHT
EQUAL THICKNESS	SAE 1025 Steel		100	100	100	100
	SAE 4130 Steel	Heat Tr. Sht.	100	375	100	100
	Alum. 3003-½H	½ Hard Sht.	100	44	35	35
	6061-T4	Heat Tr. Sht.	100	44	35	35
	2024-T4	Heat Tr. Shapes	100	111	35	35
	7075-T6	Heat Tr. Sht.	100	183	35	35
	Titanium A-55	Sheet & Bars	100	140	52	57
	C110M	Sheet & Bars	100	275	52	57
	Mag. AZ31-O	Annealed Sht.	100	43	22	23
	AZ31-H24	H. R. Sheet	100	73	22	23
	AZ31	Extruded Bar	100	50	22	23
	ZK60A	Extr. & Aged	100	82	22	23
	AZ80-T6	Ht. Tr. & Aged	100	88	22	23
EQUAL STRENGTH	SAE 1025 Steel		100	100	100	100
	SAE 4130 Steel	Heat Tr. Sht.	52	100	14	52
	Alum. 3003-½H	½ Hard Sht.	150	100	120	52
	6061-T4	Heat Tr. Sht.	150	100	120	52
	2024-T4	Heat Tr. Shapes	95	100	30	33
	7075-T6	Heat Tr. Sht.	74	100	14	26
	Titanium A-55	Sheet & Bars	85	100	33	48
	C110M	Sheet & Bars	60	100	12	34
	Mag. AZ31-O	Annealed Sht.	152	100	79	35
	AZ31-H24	H. R. Sheet	117	100	36	27
	AZ31	Extruded Bar	142	100	64	33
	ZK60A	Extr. & Aged	110	100	30	25
	AZ80-T6	Ht. Tr. & Aged	107	100	27	25
EQUAL STIFFNESS	SAE 1025 Steel		100	100	100	100
	SAE 4130 Steel	Heat Tr. Sht.	100	375	100	100
	Alum. 3003-½H	½ Hard Sht.	141	88	100	49
	6061-T4	Heat Tr. Sht.	141	88	100	49
	2024-T4	Heat Tr. Shapes	141	221	100	49
	7075-T6	Heat Tr. Sht.	141	364	100	49
	Titanium A-55	Sheet & Bars	125	215	100	71
	C110M	Sheet & Bars	125	430	100	71
	Mag. AZ31-O	Annealed Sht.	165	117	100	38
	AZ31-H24	H. R. Sheet	165	200	100	38
	AZ31	Extruded Bar	165	136	100	38
	ZK60A	Extr. & Aged	165	222	100	38
	AZ80-T6	Ht. Tr. & Aged	165	238	100	38
EQUAL WEIGHT	SAE 1025 Steel		100	100	100	100
	SAE 4130 Steel	Heat Tr. Sht.	100	375	100	100
	Alum. 3003-½H	½ Hard Sht.	285	358	819	100
	6061-T4	Heat Tr. Sht.	285	358	819	100
	2024-T4	Heat Tr. Shapes	285	904	819	100
	7075-T6	Heat Tr. Sht.	285	1490	819	100
	Titanium A-55	Sheet & Bars	175	420	290	100
	C110M	Sheet & Bars	175	840	290	100
	Mag. AZ31-O	Annealed Sht.	439	831	1890	100
	AZ31-H24	H. R. Sheet	439	1429	1890	100
	AZ31	Extruded Bar	439	965	1890	100
	ZK60A	Extr. & Aged	439	1580	1890	100
	AZ80-T6	Ht. Tr. & Aged	439	1700	1890	100

Reprinted from "Magnesium," published by Brooks & Perkins, Inc.

WEIGHT CALCULATOR FOR MAGNESIUM, ALUMINUM, AND STEEL



THE ABOVE NOMOGRAM PROVIDES A SIMPLE MEANS FOR CALCULATING AND COMPARING WEIGHTS OF MAGNESIUM, ALUMINUM, AND STEEL PARTS AND, INCIDENTALLY, FOR GENERAL MULTIPLICATION AND DIVISION.

1. LOCATE LENGTH AND WIDTH OF PART ON LINES ③ & ⑤ RESPECTIVELY. A STRAIGHT LINE CONNECTING THESE POINTS INTERSECTS LINE ④ INDICATING AREA OF PART IN in^2.

2. FOR MAGNESIUM AND ALUMINUM LOCATE THICKNESS OF PART ON LINE ⑦. CONNECT THIS POINT BY STRAIGHT LINE WITH THE VALUE FOUND ON LINE ④ AND READ THE WEIGHT IN POUNDS ON LINE ⑥.

FOR STEEL USE LINE ① FOR THICKNESS AND READ THE WEIGHT VALUE ON LINE ②

3. FOR PARTS WHOSE WIDTH OR LENGTH EXCEEDS 10" (OR THICKNESS EXCEEDS 1") USE THE NOMOGRAM WITHOUT REGARD TO DECIMAL POINT UNTIL THE WEIGHT IS OBTAINED. THEN MOVE THE DECIMAL POINT OF YOUR RESULT AS REQUIRED.

IF ONE, TWO, OR ALL THREE FACTORS ARE MULTIPLIED BY 10, MULTIPLY THE ANSWER BY 10, 100, OR 1000 RESPECTIVELY BY MOVING THE DECIMAL POINT ONE, TWO, OR THREE PLACES TO THE RIGHT. FOR EXAMPLE:

A MAG. PART 3"x 4"x .25" WEIGHS .19 POUNDS,
A PART 3"x 40"x .25" WEIGHS 1.9 POUNDS,
A PART 30"x 40"x .25" WEIGHS 19 POUNDS,
A PART 30"x 40"x 2.5" WEIGHS 190 POUNDS.

4. FOR GENERAL MULTIPLICATION AND DIVISION USE LINES ③④⑤.

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PRECISION TOOLS — No. 20 — 12" Master Precision Square, No. 453 Die Makers' Square with accessory blades, No. 13 — 4" Double Square, No. 55 — 6" Bevel Edge Square

precision starts with Starrett® squares

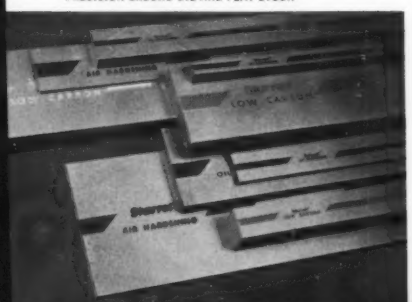
Nothing could be more precisely square than a Starrett No. 20 Master Precision Square. It is made with beam and blade hardened and ground to insure a lifetime of straightness and parallelism. The same goes for No. 55 series Bevel Edge Square and the many other squares made by Starrett.

No. 453 Die Makers' Square with graduated, bevel, offset and narrow blades is designed for angular adjustment to help diemakers, toolmakers and patternmakers check clearances, drafts and angles.

Here again, Starrett offers the widest possible choice of types and sizes — all readily available through your nearby Industrial Supply Distributor who stocks and sells the complete line of Starrett quality products. Call him — or write for complete Catalog No. 27. Address Dept. D, The L. S. Starrett Company, Athol, Massachusetts, U.S.A.

World's Greatest Toolmakers

PRECISION GROUND DIE AND FLAT STOCK



HACKSAWS, HOLE SAWS, BAND SAWS, BAND KNIVES

DIAL INDICATORS AND GAGES

The swing over the bed ways and carriage wings of this lathe is 60 inches and the swing over the cross-slide 40 inches. Spindle bearings of the headstock will carry a radial load of 140,000 pounds, at a speed of 100 rpm. The 15-inch spindle nose has an A-1 No. 6 Morse taper. The hole through the spindle is 4 1/8 inches in diameter. Face-plate diameter is 50 inches, and the spindle-speed range is 12 1/2 to 200 rpm. The face-plate driving-speed range is 2 to 50 rpm. Headstock equipment includes a horsepower meter and an electric speed indicator. Speed changes are set mechanically through two levers, and shifting gears are mounted on spline shafts.

The gear-box, for threading only, will permit cutting 54 threads in a range of 1/2 to 15 threads per inch (1 inch to 30 optional). The lead-screw is 3 1/2 inches in diameter. Travel of the cross-slide is 28 inches, and that of the tool-slide, 10 inches. Apron drive is by a 3-hp General Electric Thymotrol unit. Longitudinal feed is infinitely variable from 0.0136 to 272 ipm. Cross-feed is infinitely variable from 0.0136 to 54 ipm.

The tailstock spindle has a diameter of 11 inches and a travel of 20 inches. Power traverse is 60 ipm.

Circle 591 on Readers' Service Card

Dual-Purpose Fixtures for Induction-Heating

Lepel High Frequency Laboratories, Inc., Woodside, N.Y., has developed a dual-purpose fixture for crystal-pulling and floating-zone applications for use with their high-frequency induction-heating generator. The floating-zone method equipment shown at the left in the illustration has been used extensively for zone refining and for growing crystals of high-purity silicon for semiconductor devices. The characteristics of this technique are suitable for materials with a high melting point and high chemical reactivity.

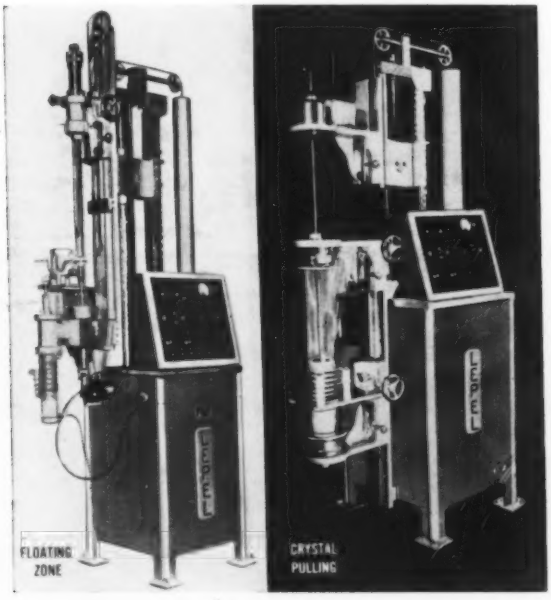
In the crystal-pulling method, using equipment shown at the right in the illustration, single crystals of various materials—especially germanium—have been successfully grown. In this method a seed of known crystal orientation is brought into contact with the surface of the molten metal and slowly withdrawn, producing progressive crystallization.

Circle 592 on Readers' Service Card

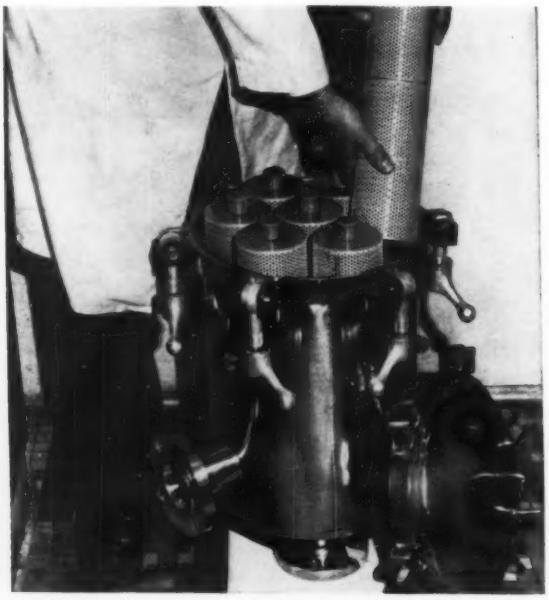
"Triphane" Filter for Hydraulic Oil

Hydraulic and other petroleum-based fluids and water can be filtered to absolute 3-micron cleanliness by means of the "Triphane" filter assembly developed by Aircraft Porous Media, Inc., a subsidiary of Pall Corporation, Glen Cove, N. Y. This filter has capacity ratings up to 170 gallons per minute continuous flow. No recirculation or preliminary filtration is required. The unit, developed originally for use in processing bulk MIL-H-5606 hydraulic oil before packaging, features an extremely high dirt-filtering rate or capacity.

The heart of the unit consists of a combination fiber-glass membrane, primary throw-away cartridge. The fiber glass provides fine filtration coupled with large dirt capacity; the membrane removes all particles larger than 3 microns and prevents migration. The primary cartridges are followed by the third-stage "Rigimesh" corrugated wire-mesh filter elements, which provide 98 per cent 5-micron filtration and absolute 18-micron filtration. The mesh elements protect the system during element changes and in the



Lepel induction-heating generators with (left) floating-zone and (right) crystal-growing fixtures



Triphane high-capacity filter for hydraulic and other petroleum-based fluids and water

event the primary cartridges are damaged or omitted. Housings are made of stainless steel and are rated at 125 psi. They are available with the optional Deltadyne differential pressure indicator to show when filter elements need replacement.

Circle 593 on Readers' Service Card

Floor Type Profile Grinder

A floor type, tilting-table profile grinder built to accurately grind and polish contours and irregular shapes is announced by the Star Cutter Co., Farmington, Mich. This new No. 3 machine, which is especially suited to work in tool and die shops, toolrooms, and low-production plants, has the grinding wheel mounted on a vertical reciprocating spindle. The grinding wheel is in the center of a counterweighted 18-inch diameter round work-table that is accessible from all sides.

In grinding a contour on a part, the vertical, slide-mounted table is unlocked, raised with a capstan handwheel, and locked to bring the part in correct vertical contact with the reciprocating grinding wheel. The part is then moved on the table around the wheel by hand to bring the desired work areas into wheel contact. If necessary, another table lock can be released to permit the table to be tilted and relocked for finishing angular work-surfaces.

Standard pencil and cup type grinding wheels up to 4 inches in diameter can be used on the machine. Larger sizes of cup wheels are mounted on an arbor provided with the machine. Interchangeable center plates for the table provide suitable work-surfaces for the various wheel sizes.

The grinder has wheel speeds of 4500, 6500, and 10,150 rpm. Total wheel reciprocation is 3/16 inch. The wheel makes ninety reciprocations per minute. A 1 1/2-hp motor powers the grinder, which occupies a 24- by 30-inch floor space and has a table height of 38 to 44 inches.

Circle 594 on Readers' Service Card

Ultrahigh-Speed Automatic Open-Back Inclinable Stamping Presses

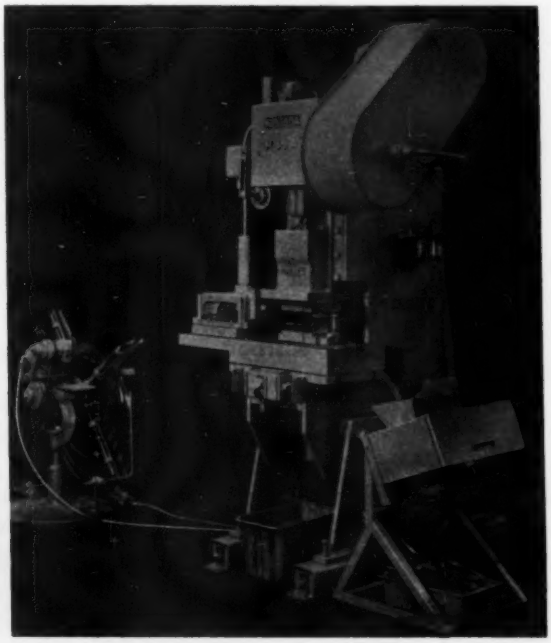
A line of automatic ultrahigh-speed open-back inclinable presses designed to boost production and reduce costs on short-stroke stamping jobs has been introduced by Niagara Machine & Tool Works, Buffalo, N. Y. The 35-ton machine shown operates at speeds up to 1000 strokes per minute in producing parts at a rate of more than a million per day. Featuring an extra-rugged, welded, all-steel frame, low inertial slide and connection, and nonmetallic ways, the new Series M presses are available in 22-, 35-, 45-, and 60-ton capacities (both nongeared and single-geared). Shaft diameters range from 2 1/2 to 4 inches. Fully enclosed drives provide safer, cleaner press operation, as well as improved appearance.

The slide is designed specifically to meet the requirements of high-speed, precision stamping work. It has unusually long and rigid guides. Large mounting space is available and the symmetrical arrangement around the point of load application gives solid support and longer life to the dies.

Circle 595 on Readers' Service Card

(*This section continued on page 182*)

Star No. 3 profile grinder specifically designed for tool and die shops, toolrooms, and small-lot jobs

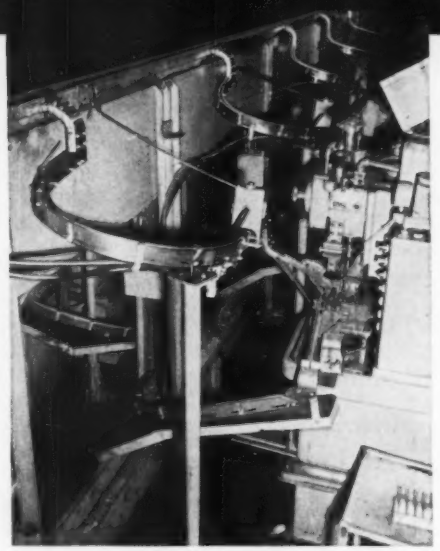


Niagara automatic open-back inclinable press designed for high-speed stamping jobs

MICROHONING* pinion gears...

Simplifies processing, provides efficient production,

A major manufacturer of regular and compact cars has selected Microhoning as the most efficient method for securing consistent precision, controlled surface finishes, and simplified processing. Microhoning is used on the flat surfaces and bores of a number of transmission gears plus the O.D. of a housing hub. HERE'S HOW!



After the final flat-Microhoning operation, gears for use in large transmission are automatically conveyed overhead to a group of eight Microhoning machines, set up in two facing rows of four each. After bore Microhoning, finished gears are "tracked" to a lower conveyor which carries the part to the final operation of teeth polishing.

Flat-MICROHONING Simplifies Processing

Double surface Microflat machines simultaneously Microhone both flat surfaces of pinion and sun gears. First, the soft gear blanks are flat-Microhoned to secure thickness and parallelism within .0003″, and a finish of 30 microinches (rms) or better. This simplifies subsequent operations by eliminating the former necessity of orienting the gears to a single finished surface.

The second flat-Microhoning operation occurs after the part has been bored, hobbed, teeth shaved, chamferred, and the gear has been heat-treated to a hardness of 59 R "C". This final flat-Microhoning quickly cleans up all burrs while generating required final accuracies and surface finish.

Efficient Production

After the second flat-Microhoning operation, gears are conveyed to Microhoners for processing the bores. Typical of the production efficiency realized on all gear bores is the bore-Microhoning of pinion gears (nine are used in each large transmission).

On eight Microhoners these pinion gears are automatically loaded, positioned, bores Microhoned, checked for size, segregated and ejected. This wholly automatic sequence takes about 18 seconds per gear. Only one set up man is required to keep all eight machines in operation.

An average of .002″ stock is removed from each .504″ D. x ¾″ L. bore; generated surface finish is 10 microinches, rms; roundness and straightness are held within .0001″ tolerance; diameter within .0003″.

The smaller transmission uses pinion and sun gears having various bore sizes (.697″ D. x ¾″ L., .697″ D. x 1-3/32″ L., 1.030″ D. x ⅞″ L.). To generate roundness, straightness, size and surface finish, these bores are processed on five double-spindle Hydrohoners equipped with shuttle-type fixturing. Straightness and roundness are held within a .0003″ tolerance, diametric size within .0005″. All gear bores are processed in an average 26-second cycle that includes loading, Microhoning and ejection.

Microhoning is an efficient precision production process that assures consistent results. Also, reliable precision on component parts is a prime answer to "Why" better performing automatic transmissions are obtained.

**Registered U.S. Pat. Off.*

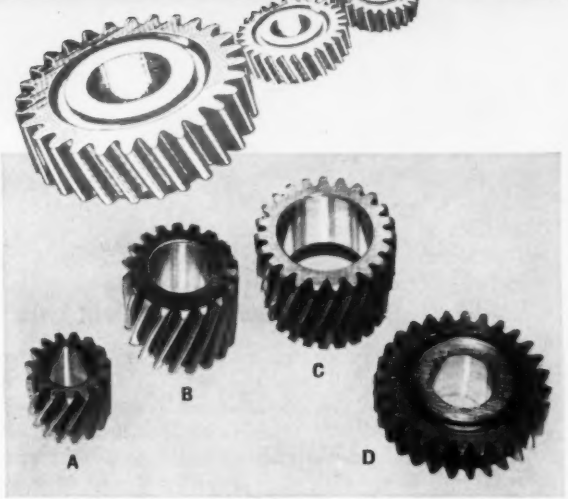
PRECISION PRODUCTION THROUGH MICROHONING
MICRO MATIC

assures quieter-running transmissions

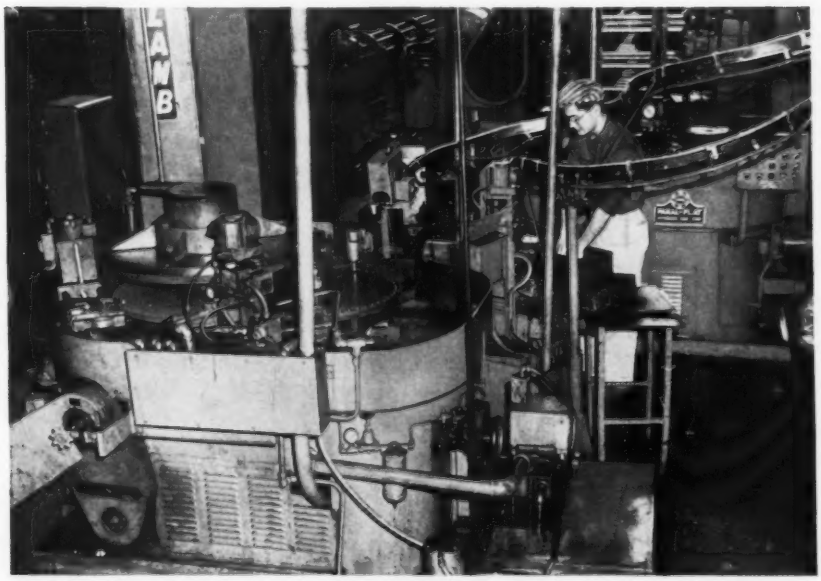
MICROHONING Increases Seal Life

In addition to flat surfaces and bores of gears, the converter housing hub of the large transmission is also Microhoned. Hub O.D. is 1.936″, length is about 2″, and it has a blind end with ¼″ relief. Two progressive Microhoning operations remove a total of about .004″ stock to generate a surface finish of 15 microinches in a cycle time of 45 seconds per part.

During the last few strokes of the Microhoning tool in the finishing operation, the reciprocation is slowed down so that the surface finish lay marks run circumferentially around the hub. This pattern is specified so that the lay is in the same direction as the axis rotation of the oil seal which later will be assembled on the hub. This compatibility increases the life and effectiveness of the seal.



Types of gears Microhoned for automotive transmissions. Nine of gear 'A' are used in the large transmission, while three each of gears 'B' and 'D', and one each of gear 'C' are designed for the compact car transmission.



MODERN MACHINE TOOLS MMT=PE PRODUCTION EFFICIENCY

The two parts-chutes feeding the Paral-Flat machines encircle an operator who is checking parts. One machine handles the blanks, while the other does the flat-Microhoning operation following heat-treatment of the gears.

For further examples or information on the effectiveness of MICROHONING flat surfaces, bores or outer diameters, write to:

MICROMATIC HONE CORPORATION

8100 SCHOOLCRAFT AVENUE • DETROIT 38, MICHIGAN

For more data circle this page number on card at back of book

Fosmatic turret drill with tape control over its thirty-two spindles

Tape-Controlled Turret Drill with Tool-Crib

A numerically controlled Fosmatic turret drill recently announced by the Fosdick Machine Tool Co., Cincinnati, Ohio, is virtually a drilling department in one machine. With a single complement of tools in its thirty-two-spindle turret, the drill can perform an estimated 90 per cent of all the drilling-tapping jobs in the average shop. This means that at one time the spindles on this machine can store all the drilling, reaming, tapping, milling, and counterboring tools needed for hundreds of different jobs. They are ready for action at the command of a simple punched tape. Positioning and turret selection are controlled by a General Electric system that provides accuracy of plus or minus 0.001 inch.

Use of this new machine is expected to allow drilling departments to reach new levels of profitability. Jigs and fixtures—with their high initial cost, long lead time, and storage problems—can be eliminated entirely. In their place are compact tapes and a few work-holding devices.

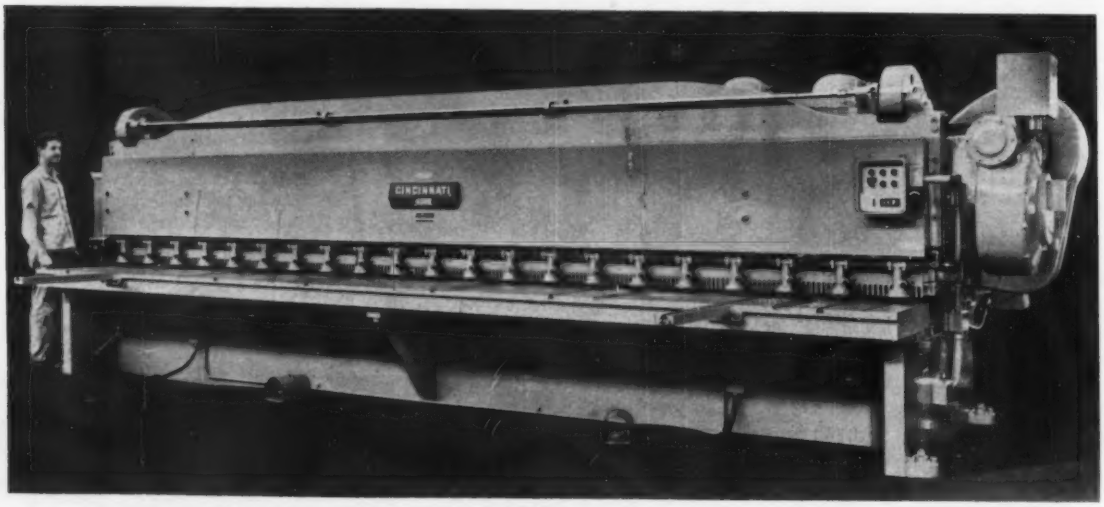
Speed, convenience, versatility, and accuracy are the salient qualities of this drill. The thirty-two spindles, arranged on a turret wheel around the machine's center column, index to the work by the shortest route. Spindles are available for drilling, lead-screw tapping, and heavy-duty milling. The machine has ample power (3 hp) to handle a 1 1/2-inch drill in cast iron and is capable of tapping a No. 2-56 thread. The spindles have eight feed rates, ranging from 0.001 to 0.030 ipr, and sixteen speeds, ranging from 65 to 2500 rpm. Feed is also provided on both table and saddle for point-to-point milling.

Circle 596 on Readers' Service Card

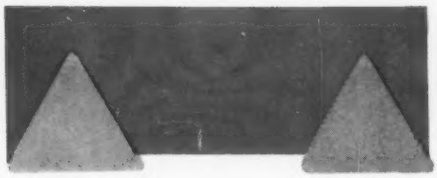
Cincinnati All-Steel Shear with Back-Gage

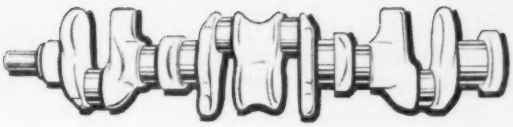
A Series 4320 shear which has a cutting capacity of 3/16 inch by 20 feet in mild steel is one of the latest machines of this type manufactured by the Cincinnati Shaper Co., Cincinnati, Ohio. Back-gage adjustment of 36 inches is front-controlled and power-operated for quick, easy blank-width settings. Automatic pressure lubrication, a long work chute at the rear of the machine, ball transfers in the table to facilitate plate handling, and hydraulic hold-downs are added features.

Other specifications include: distance between housings, 20 feet 3 inches; throat, 18 inches; ram adjustment for slitting; inclined ram; electric clutch control

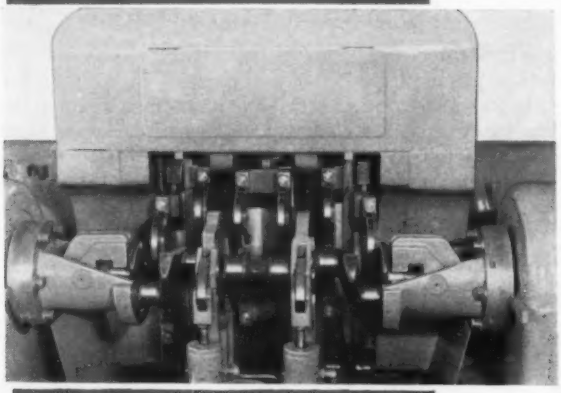


All-steel shear with hydraulic hold-downs brought out by Cincinnati Shaper Co.





QUICK-CHANGE VERSATILITY!



Yours since 1955 with WICKES highly versatile MP-4 cartridge-type Crankshaft lathe.

1955 produced a forecast of the future when WICKESmanship developed and introduced the highly adaptable MP-4 Crankpin turning lathe. A true quick-change artist, the MP-4, utilizing a master crankshaft as a template, is designed to turn three different types of crank shafts, turning and cheeking all crank pins at one time. A quick change of the center section on the MP-4 accommodates different spacing of crank pins, as well as different strokes. Master crankshafts can also be changed quickly to handle crankshafts of identical design but with different strokes. Production efficiency proven in steel . . . and on the job . . . since 1955!

The center section . . . heart of the MP-4 . . . can be changed in 4 hours, master crankshafts changed in 2 hours! These are actual changeover times clocked on the job. Your WICKESman is ready to show you how the versatile MP-4 lathe . . . developed by WICKESmanship in 1955 . . . can truly cut your production time and costs in the 60's. Call him today.

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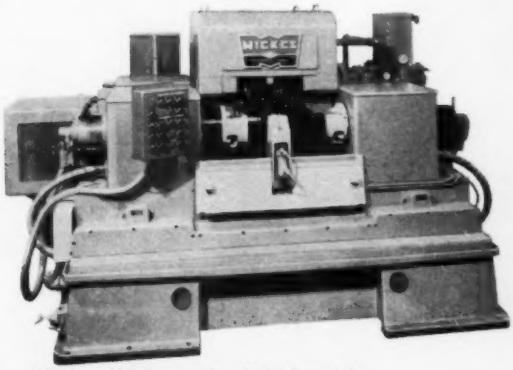


MP-3 . . . MP-8 . . . and . . . MP-10 models are also available in this production-proven series.

"More than a century of machine tool progress".

For more data circle this page number on card at back of book

with two foot-operated buttons; front gage and support arms; and 20-hp electrical equipment.

Circle 597 on Readers' Service Card

Delta Cutoff Machine

A considerable increase in power and capacity, with no increase in price over the previous model, plus hollow-arbor mist cooling and a retractable size-gage are features of a new "swinging arbor" 12-inch cutoff machine developed by the Rockwell Mfg. Co.'s Delta Power Tool Division, Pittsburgh, Pa. This new unit handles 1 1/2-inch diameter solid round bar steel on a production basis, as compared to the 3/4-inch capacity of the previous machine. Other production capacities of the new machine are 2-inch thickness and 8-inch width on wood and plastic, 3 1/4-inch diameter on nonferrous tubing and solid round bar, and 3 1/4-inch diameter on ferrous tubing. It cuts 3- by 3-inch angles and 4-inch channels. The 12-inch blade cuts bar stock and angles used in maintenance work.

For cutting nonferrous materials, Delta's patented coolant arrangement brings oil down from the reservoir to the hollow blade arbor and discharges it through two radially placed port holes, one on each side of the blade. A "slinging" action provides complete mist lubrication down both sides of the blade, to the work, without the aid of compressed air.

With an abrasive wheel, the machine can cut to a tolerance of less than 0.005 inch. This accuracy is achieved by a combination of high power (5 hp) and high surface speed (over 12,500 rpm), plus the use of a new retractable size gage. The gage—designed for this machine—compensates for the accuracy-destroying heat expansion created during abrasive cutting of ferrous pieces. When the workpiece is butted against a conventional stop and clamped, the expanding metal binds against the abrasive wheel, causing a poor cut. The Delta retractable size gage eliminates this problem. After clamping the work, the operator moves a lever on the gage which retracts about 0.010 inch. This provides space for heat expansion.

Circle 598 on Readers' Service Card

Miller Alternating- and Direct-Current Welder

An alternating- and direct-current welder using single-phase service is offered in 300-, 400-, and 500-ampere sizes by the Miller Electric Mfg. Co., Appleton, Wis. Considerable versatility and a modest price are notable advantages claimed for this welder. Other features include: continuous current control; open circuit of 80 volts plus two wide-range welding currents in both alternating- and direct-current operation; straight or reverse direct-current polarity; and Miller exclusive semimetallic rectifier. Forced draft ventilation, dead-front construction, and sturdy, dripproof cabinet are additional advantages.

Circle 599 on Readers' Service Card

Delta cutoff machine using hollow-arbor mist cooling

Welder offered in three sizes by Miller Electric Mfg. Co.

CUTS MANUFACTURING COSTS OF EXPORT PARTS TO MEET FOREIGN COMPETITION

Assignment was to design and build a machine to process large domestic aluminum transmission covers through one sequence of operations and smaller export covers through a different sequence. One machine to do both jobs would, naturally, save money. The job was slightly complicated by production ratio of one export part to four domestic; the machine to accept these parts intermixed at random and run them through automatically.

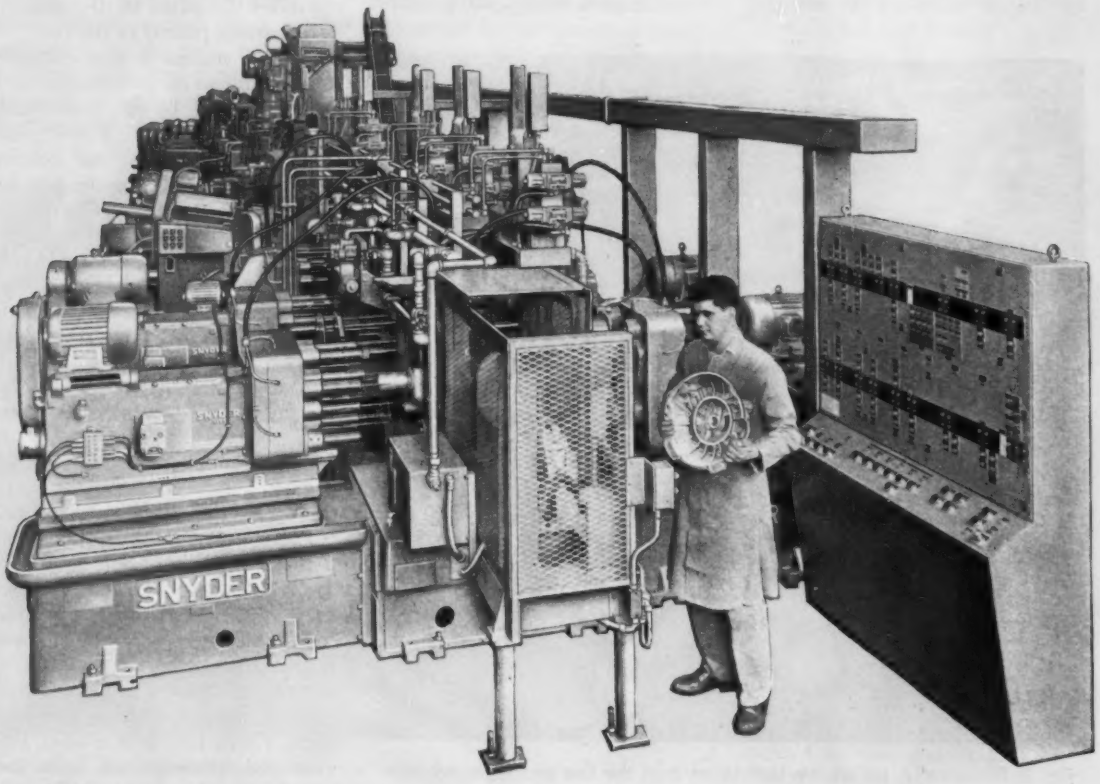
The assignment was carried out successfully and covers made here are built into foreign cars at cost competitive with local production overseas.

The fact is that U. S. experience, know-how, fresh approach and creative ideas *can build and are building* machines to offset foreign cost advantages. And the same cost-cutting techniques can be built into machines to offset regional manufacturing cost differences. Here at Snyder we're particularly experienced in this because we've been designing and building such machines for both domestic and export markets for 35 years. May we help you?

SNYDER

CORPORATION

3400 E. LAFAYETTE—DETROIT 7, MICHIGAN
Phone: LO 7-0123



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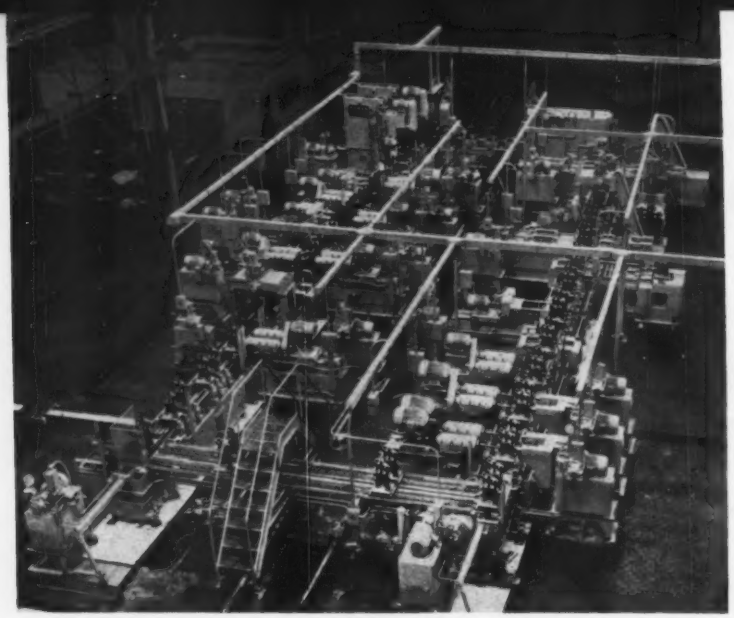
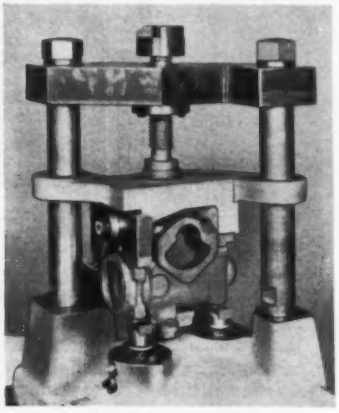


Fig. 1. (Left) Cross pallet type Transfer-matic precision-machines irregular power-steering-gear housings from four sides at rate of 300 per hour

Fig. 2. (Below) Unmachined castings are clamped in pallets



Cross Transfer Machine for Processing Power-Steering-Gear Housings

A pallet type Transfer-matic (Fig. 1) designed by The Cross Company, Detroit, Mich., machines power-steering-gear housings, permits in-process inspection, and accomplishes assembly operations more accurately and in less time than was possible on a series of separate machines. The irregular-shaped parts are located and clamped only once in pallets such as shown in Fig. 2.

The unmachined malleable-iron castings are loaded into the pallets and processed two at a time around the closed-loop, thirty-eight-station Transfer-matic on a twenty-four-second cycle. With two parts simultaneously processed in each station, 300 parts per hour are produced at 100 per cent efficiency. The pallets which transport the work-pieces from station to station are of "open" design, Fig. 2, so that tools have access to all four surfaces of the housings. Rotators are used in two locations to index the pallet 90 degrees.

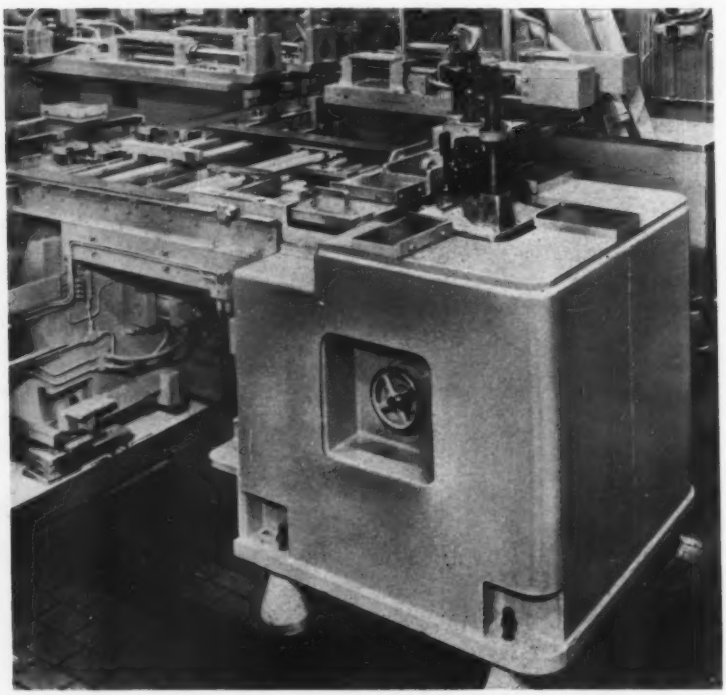


Fig. 3. Periodically, pallets are withdrawn from the line and replaced with spares at this inspection station of machine shown in Fig. 1

A casting placed in the pallet at the load station is automatically aligned by an air-powered pusher, and clamped by an electrically powered wrench. Fixed and equalizing locators and clamp jaws in the pallet compensate for any casting variations. The clamps are automatically released at the unloading station. Pitman cover faces are rough- and finish-milled at the first two stations. Carbide milling cutters on vertical columns are used in both stations. Brazed-carbide cutter blades and bodies mounted on adjustable adapters are precisely preset.

Rough and semifinish boring are done with boring-bars having outboard support. These operations prepare the part for accurate boring in the finishing operation. Accuracy—for concentricity, diameter, and location—of the related holes is achieved in the finish-boring station. Here, a controlled amount of stock is removed from each of the holes and a standard Cross V-way feed unit is used. Pitman and steering-shaft holes are bored concentric within 0.004-inch

true indicator reading and to diameter tolerances as close as plus or minus 0.001 inch.

Several holes are drilled in the housings with drills monitored by Cross Protect-O-Tool units, which shut the machine down if a drill should break. These holes are tapped in a succeeding operation. After the taps have been withdrawn, the tool-head shuttles longitudinally so that probes—mounted on the same head—can be inserted in the holes to make sure there are no broken taps. All internal edges of surfaces and holes are deburred. Most deburring is accomplished with powered wire brushes eccentrically mounted to compensate for wear. One through hole is deburred by a fork-like tool that is pushed through the hole and deburrs on the withdrawal stroke.

To assure accuracy, provision has been made for inspection stations monitored by roving inspectors. Surface plates are permanently mounted in three otherwise idle stations, and fixed gages are kept at these stations so that the inspectors can check the accuracy of machining operations during the machining cycle. After all machining operations have been performed on the part, but prior to the assembly and deburring operations, pallets pass a major inspection station, Fig. 3. Here, one or both pallets in the station can be pulled off the line and replaced with spares. Surface plates, fixed gages, and a pallet-tipping mechanism permit complete inspection of the pallet as well as the workpiece. By including this station before the assembly operation, waste and scrap are guarded against.

A worm-thrust-bearing cup and a pitman-shaft bushing, Fig. 4, are assembled in each housing after all machining operations have been completed. Basic operations in the two assembly stations are the same. Independent backup units, for both pallet positions in each station, feed out to support the parts.

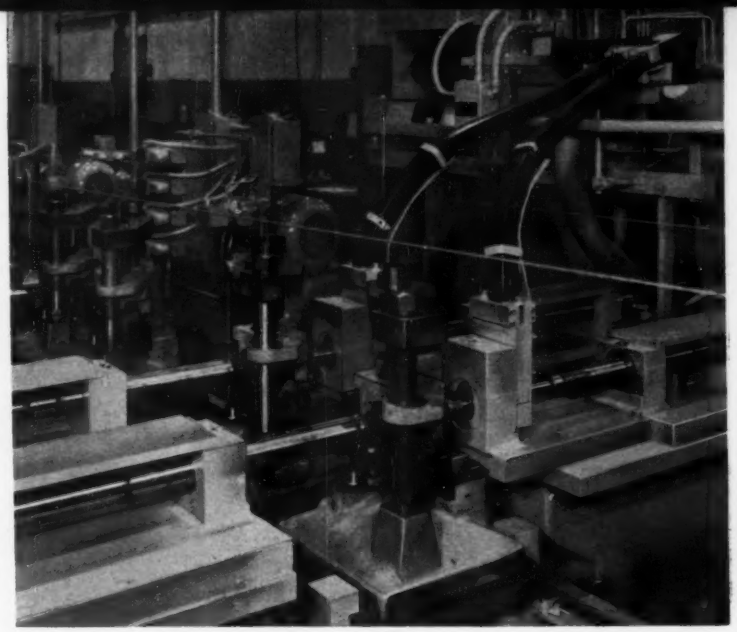


Fig. 4. Bushings are automatically gaged to be sure they have been properly machined before assembly at this station of Cross Transfer-matic

Pneumatic Recorder for Quality Production Control on Jig Borer

Pneumatic gage recorders made by the Sheffield Corporation, Dayton, Ohio, have been applied to eight automatic-indexing jig-boring machines at the Evandale, Ohio, plant of the General Electric Co. Each recorder is equipped with maximum- and minimum-tolerance lights, index-chart drive, and a buzzer signal. An adjustable bracket is mounted to the quill of the jig borer to hold a floating spring-urged air spindle.

After the first hole is bored, the air spindle automatically gages and records the size. If the size exceeds a preset limit, the recorder buzzer sounds, warning the operator to make the necessary adjustments before the boring tool starts to enter the next hole. This use of the pneumatic recorder not only affords a potential reduction in scrap, but it can also forewarn of such things as tool wear and possible tool breakdown. In one instance, the design of the boring tools was changed to give them longer life.

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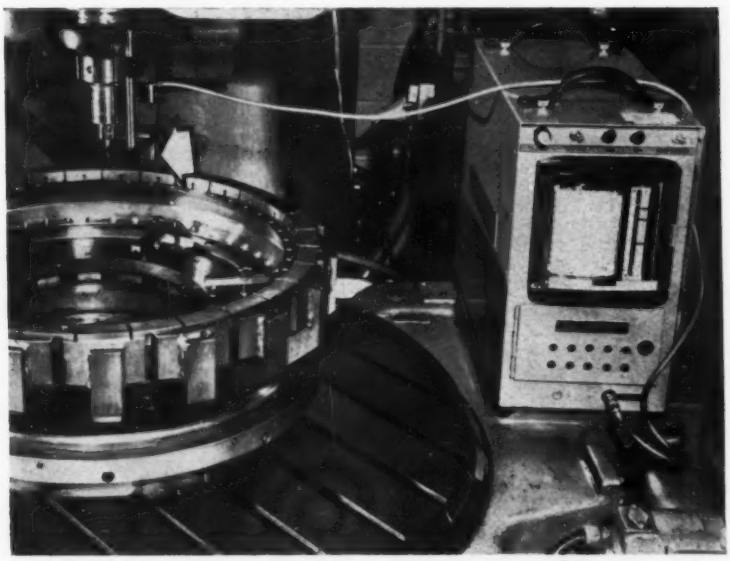
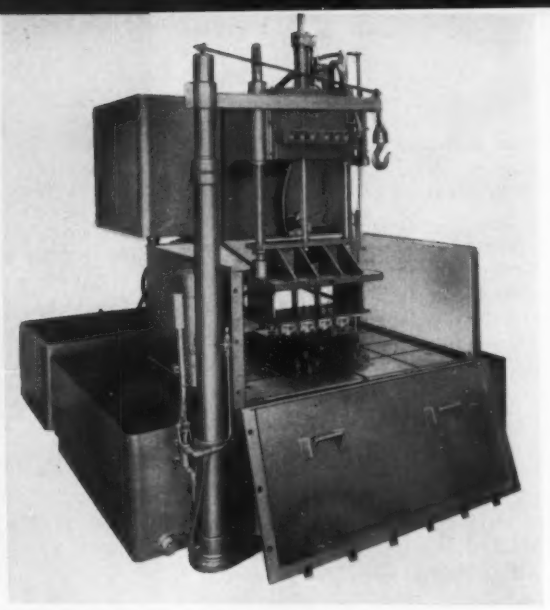


Close-up of Sheffield pneumatic gage recorder on jig borer. The arrow points to air-gage spindle shown in nongaging position

Fig. 1. Stokes 200-ton automatic transfer molding press



Die-Matic shown with door of dielectric tank dropped

Stokes Automatic Transfer Molding Press

A 200-ton Model 741 AT automatic transfer molding press has just been delivered to the midwest plant of a leading manufacturer of electrical switches by the F. J. Stokes Corporation, Philadelphia, Pa. This machine, Fig. 1, has an improved, more flexible, fully automatic system for feeding preforms into the preheater shown at the left and moving the heated charge into the molding area. The press also has a new combing and ejection system which automatically separates the cull and runners from the molded pieces.

Fig. 2 is a close-up of the improved system for feeding preforms into the automatic transfer molding press shown in Fig. 1. The circular preforms are fed from a vibratory bowl which "walks" them up a spiral ramp (foreground) and discharges them by way of a gravity chute into an automatic stacking and counting device. When the predetermined number of preforms for one "shot" has been stacked, the charge is automatically lifted to the clamping device and moved horizontally into the LaRose preheater (at right). After the charge has reached the proper temperature, the hot stack is withdrawn from the preheater and moved automatically into the molding area and dropped into the transfer pot.

Circle 601 on Readers' Service Card

Easco "Die-Matic" for Electrical-Discharge Machining of Large Die-Blocks

Die-blocks 3 by 4 feet, and weighing up to 6000 pounds, can be electrical-discharge machined by the new "Die-Matic" now available from Easco Products, Inc., Ann Arbor, Mich. This machine stands 7 feet high, weighs 3500 pounds, and occupies 81 by 103 inches of floor space exclusive of the rotary impulse generator and Mark III electrical power pack. Claimed to be the largest electrical - discharge machining unit so far developed, this Die-Matic equipment rough-removes metal at the rate of 6 cubic inches per hour. The ratio of metal-to-electrode wear in the roughing operation is maintained at from 30 to 1 up to as much as 50 to 1.

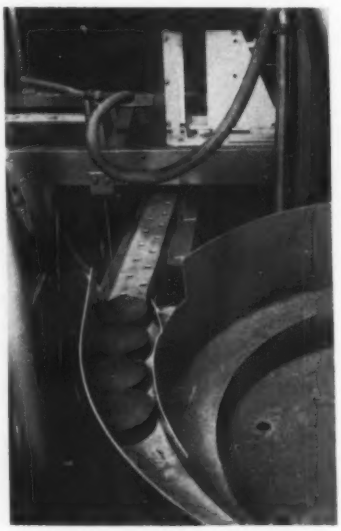


Fig. 2. Preform-feeding system of machine shown in Fig. 1

The machine is designed on the building-block style, and will handle electrodes as heavy as 500 pounds and as small as 0.005 inch. A compound table can be added to the platen, and such accessories as rotating attachments, centering microscope, and tramming device are also available.

The Die-Matic is fully automatic, as the name implies. Controls can be set for the complete rough cutting, and the machine left for the run, except for the replacement of the electrode. The same is true for the precision finish. In typical situations, one man can attend up to four machines.

Standard features include a 36- by 48-inch work-table, 200-gallon work tank (fillable in five minutes), portable dielectric supply tank capable of handling 800 gallons, 18- by 24-inch T-slotted electrode platen which can accommodate electrodes weighing up to 500 pounds, electrohydraulic servo with 18-inch vertical travel, and 30-inch open gap between bottom of platen and top of work tank. Easy block loading is made possible by a manually operated hydraulic hoist with swing boom.

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CUSTOM GEARS AND GEAR BOXES
achieve *uniformly top quality* in making your gearing designs precisely to your specifications.

Ask for this brochure—CINCINNATI custom gears are made in all types to 72" diameter cut teeth, 39" shaved teeth, 25" ground teeth.

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THE CINCINNATI GEAR CO.
Cincinnati 27, Ohio
Custom Gear Makers Since 1907 GEARS, good gears only

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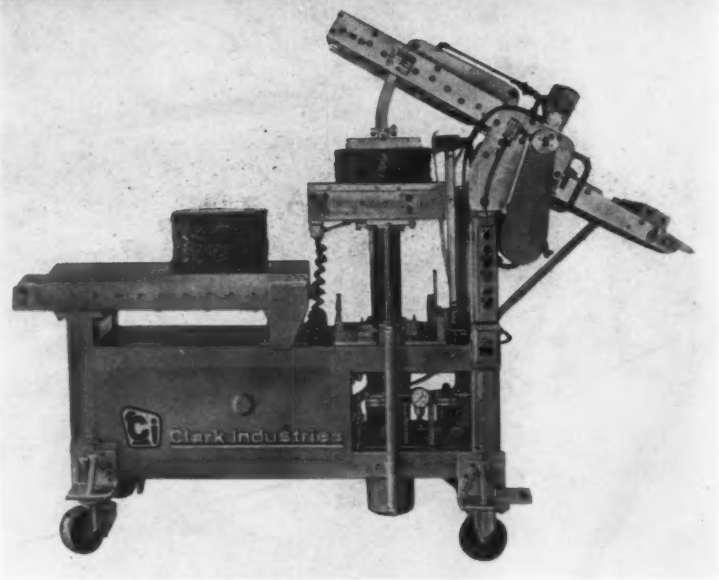
Automatic High-Speed Flat-Blank Feeder

A fully automatic, high-speed stack-top feeding machine for flat metal blanks is now being built by Clark Industries, Delaware, Ohio. The versatility of this new feeder is said to make it equally applicable in low- and high-production metalworking plants. The device is especially suited for feeding rectangular, round, square, perforated, notched, or irregular-edged blanks for secondary press or allied operations. It features one-at-a-time magnetic pickup of blank from top of work stack. Powered magnetic rolls and magnetic belt transfer the blank from pickup to operating machines, maintaining full part control and alignment.

The powered roller section is designed for receiving up to 18-inch high stacks of blanks directly from company conveyor, lift truck, or crane. The hydraulic-lift section automatically maintains stack level at pickup and returns for new stack from roller section. The self-contained, caster-mounted unit permits quick removal for die change or shift from one operating machine to another.



Fully automatic flat-blank feeder announced by Clark Industries

Feeder models and sizes are available to accommodate flat ferrous-metal blanks from 10 inches in diameter to 30 inches square and 0.015 to 0.125 inch thick. Operating speeds range up to 100 parts per minute.

Circle 603 on Readers' Service Card

Hartford Automatic Thread-Rolling Machine

The Hartford Special Machinery Co., Simsbury, Conn., has introduced a completely new automatic thread-rolling machine, designated Model 400-R, which will be distributed by Roy Machine & Sales, Inc., Farmington, Conn. This machine is capable of threading from 135 to 400 pieces per minute. A large-capacity hopper is provided which has an infinitely adjustable speed range of 4.5 to 11.5 rpm. Thread lengths can be rolled from 1/8 through 1 1/2 inches and can be extended through 3 inches with special dies. Screw-size capacity is from No. 2 through No. 10 on the automatic model (400-R) and No. 0 through No. 10 on the manual model (400-M). Simplified design provides for faster, easier setups.

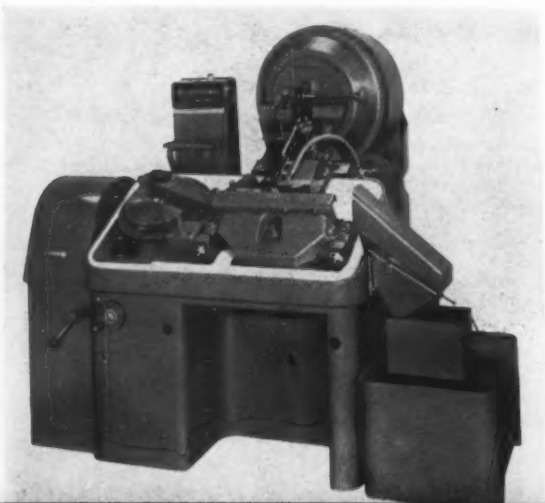
These new models feature straight-line feed rails which minimize wear and provide trouble-free feedings. A simple mechanical type feed-rail vibrator assures uninterrupted feeding of blanks. The Model 400 also offers many other new features, including vinyl-lined hopper and separate coolant system.

Circle 604 on Readers' Service Card

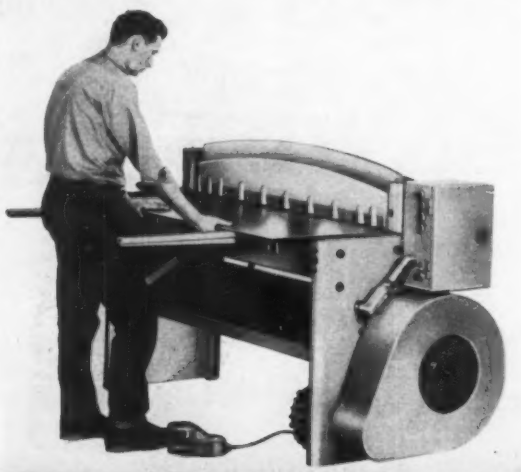
High-Speed Power Shear

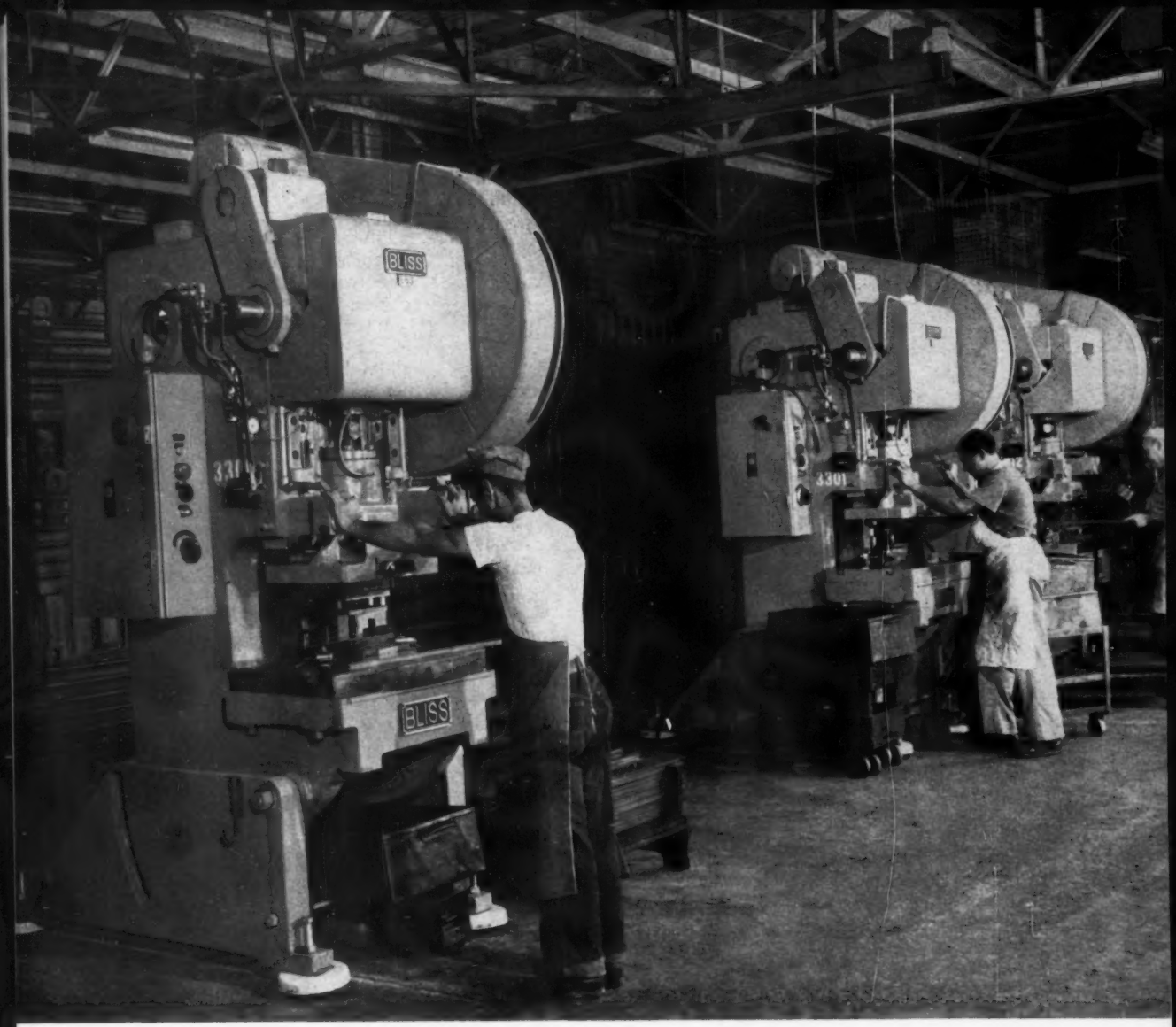
Cutting action that takes place within one-fifth of a second is a feature of a new high-speed Di-Acro No. 48 power shear introduced by the O'Neil-Irwin Mfg.

Automatic thread-rolling machine introduced by the Hartford Special Machinery Co.



Movable foot control on Di-Acro shear enables operator to stand in most convenient position





New Bliss inclinables take front seat at American Seating

Shown here are three of four new Bliss C-60 inclinable presses recently installed at American Seating Company, Grand Rapids, Mich. All four presses get day-in, day-out use in a variety of operations . . . they blank, draw, pierce, perforate, punch, trim, form and notch many types and sizes of sheet metal parts that American Seating, world's largest producer of fine institutional furniture, uses in its lines of chairs, desks and other furniture. The new "C" inclinables, with their extremely rugged frames, large bed area and long stroke adjustment, are well-suited for this general-purpose service, with its frequent die changes and strenuous single-tripping. All presses are non-geared and equipped with the Bliss CK crankshaft-mounted air-friction clutch and brake.

If you would like details of Bliss' new "C" inclinables, we will be glad to send you a free copy of our Bulletin 2F. Illustrated in color, it is yours for the asking. Or, if you prefer, our local representative will be happy to give you complete information.

BLISS
SINCE 1857

BLISS is more than a name—it's a guarantee

E. W. BLISS COMPANY · Hastings, Michigan

Foreign Subsidiaries: E. W. Bliss (Canada) Ltd., E. W. Bliss (England) Ltd.
E. W. Bliss Co. (Paris) France, E. W. Bliss-Henschel G.M.B.H., Dusseldorf, West Germany

PRESSES • ROLLING MILLS • ROLLS • DIE SETS • CONTAINER MACHINERY • CONTRACT MFG. • PUBLIC SAFETY

Co., Lake City, Minn. Ferrous and nonferrous material can be sheared in widths up to 50 inches and as heavy as 16-gage mild steel at 160 strokes per minute.

Instantaneous cycling—no pause or hesitation—is possible because the shear is equipped with a self-adjusting electric clutch built into the flywheel and connected directly to the motor by means of a triple V-belt drive. This eliminates gears and assures quieter operation. Standard equipment includes motor, all electrical equipment, automatic hold-down bar, micrometer-operated back-gage, front-gage bar and bracket, side-squaring gages, reversible protractor gage, one set of four-edged blades, and movable foot-trip control.

Circle 605 on Readers' Service Card

Gisholt Automatic Single-Cutter Turner for Lathe

The Gisholt Machine Co., Madison, Wis., is introducing a single-cutter turner with automatic tool relief for use on its Masterline AR lathes. Lathes equipped with these new turners are said to save time and cut costs on either long-production runs or small-lot jobs. Automatic, air-operated, cam-controlled tool relief and automatic recocking after clearing the work are features which make the use of this unit on the Gisholt Masterline AR lathes especially advantageous. All movable parts are adjustable for wear. Except for the base, all other components are interchangeable between the Models 4AR and 5AR lathes.

This rigidly constructed flange-mounted tool provides for maximum metal removal with carbides while providing high repeat accuracy and fine finish. Designed so that they will not interfere with each other, even when mounted on adjacent turret faces, they can be used on any or all stations, as well as with all other standard tools. The roller arms and rollers furnished with the standard No. 14119 and No. 15119B provide a turning range of 5/8 to 2 1/2 inches. A lower range of 1/8 to 5/8 inch can be had with an additional set of arms and rollers, giving a combined range of 1/8 to 2 1/2 inches.

In operation, when the turret indexes, a limit switch causes an air cylinder, mounted on the tool, to actuate a cam that positions and locks in the cutter.

Circle 606 on Readers' Service Card

Dial Type Versatile Assembly Machine

The Bodine Corporation of Bridgeport, Conn., announces the addition of a Model 60 assembly machine to its standard line of dial type multiple-operation machines.

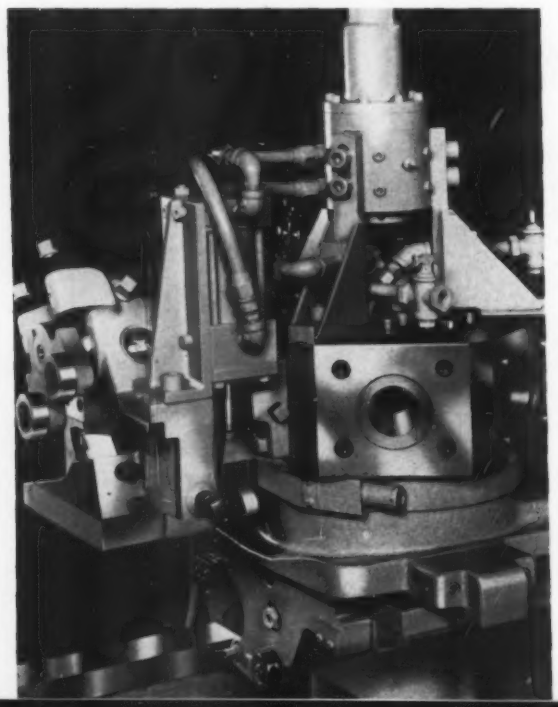
Like all Bodine dial type machines, the indexing and tooling motions are all controlled from one central camshaft. Power pick-offs from the central camshaft provide auxiliary camshafts and sprockets to actuate tooling timed directly with the main camshaft.

This machine is specifically intended for assembly work and has been designed around many of the recommendations of companies operating automatic assembly equipment. It is ideally suited for the assembly of a large number of components combined with the in-process inspection of the assembly, stage by stage. Coining, staking, crimping, and inserting operations are easily performed from the moving tooling platform without any auxiliary power source. Tooling can be mounted inside, outside, above, and below the indexing work-table with power take-offs in all tooling areas.

Circle 607 on Readers' Service Card

(This section continued on page 204)

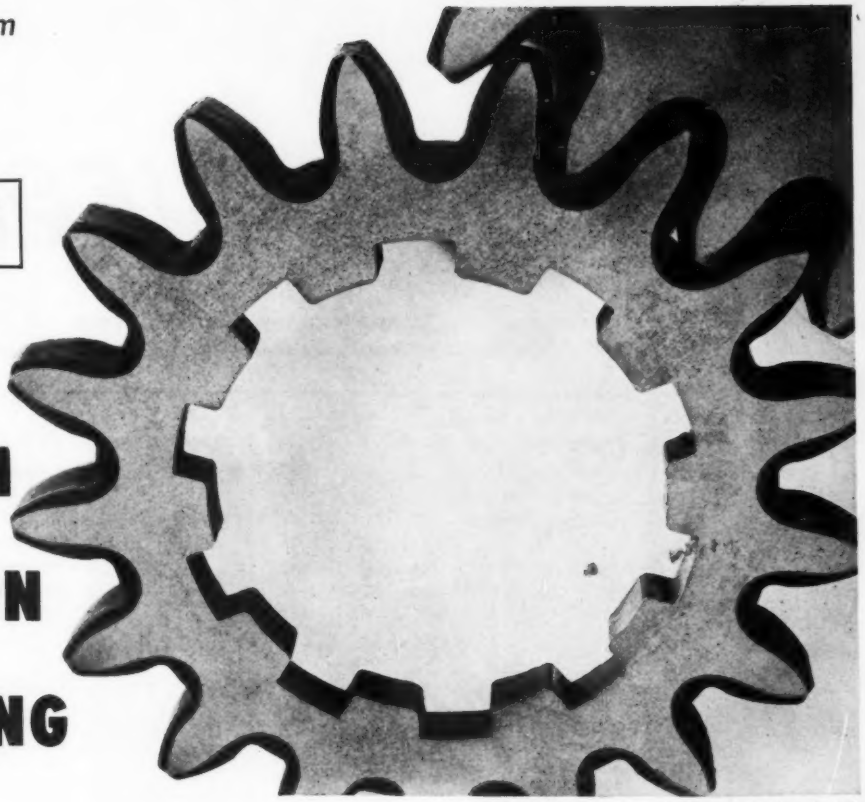
Gisholt automatic single-cutter turner mounted on turret of manufacturer's Masterline lathe



Bodine dial type multiple-operation assembly machine adapted for in-process inspection

at Farrel-Birmingham

NEW S & F TOOTH-TO-TOOTH INDUCTION HARDENING



Typical hardening pattern along flanks and through root.

...produces toughest gears yet!

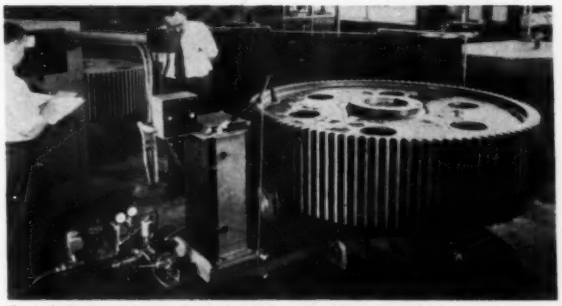
There's nothing like the S & F method of tooth-to-tooth gear hardening. Not only does it add amazing durability to big gears, but load-carrying capacity is vastly increased. Warpage can be insignificant depending on gear design. And there can be substantial savings in material and machining costs!

Farrel-Birmingham tells us that in one installation large gears with S & F induction-hardened teeth have already gone through over two years of rugged service with absolutely no sign of wear—whereas formerly, gears had to be *replaced* every two years. Reports of other installations are also highly satisfactory.

Precision controls maintain constantly accurate time, current, feed and distance between coil and workpiece to assure consistent results. In a group of similar gears, all portions of all teeth will have the same predetermined case contour and depth of hardness. In fact, hardening depth is so accurately controlled and warpage so minute that, for a number of gears, no additional machining is required.

S & F induction hardening units capable of handling gears from 3 in. to 20 ft. in diameter and larger, are available in semi-automatic and automatic models.

Want to know how this revolutionary approach to gear hardening can fit your production? Just ask us about it.



Spur, helical and double helical gears up to 157 in. diameter and 20 in. face widths are induction hardened tooth-by-tooth in this S & F equipment at Farrel-Birmingham, Ansonia, Conn.

KO CO., INC. PRECISION MACHINERY

KURT ORBAN COMPANY, INC.

42 Exchange Place, Jersey City 2, New Jersey

For more data circle this page number on card at back of book

NEW CATALOGUES

Isabel Shamlian
Charles O. Herb, Jr.

Catalogues bring details of new products to prospective buyers in clear, concise form. Yours for the asking . . . use postcard inside back cover

Numerical-Control System

National Automatic Tool Co., Inc., Richmond, Ind. Bulletin No. 157-2 introducing Natcotrol, a numerical-control system providing two- or three-axis control for single- or multiple-spindle machines. A supplement describes a Natco milling machine.

Circle **Item 501** on Inquiry Card

Structural Tubing

Joseph T. Ryerson & Son, Inc., Chicago, Ill. Bulletin 12-3 describing square, rectangular, and round steel tubing for structural applications in the construction of buildings, machinery, furniture, fixtures, appliances, truck bodies, racks, and supports.

Circle **Item 502** on Inquiry Card

Bearings

Arguto Oilless Bearing Co., Philadelphia, Pa. Catalogue No. 511 featuring Arguto-MP oilless bearings—self-lubricating, metal-plastic bearings combining high speed and load capacities. Included are tables of dimensional tolerances, recommended press fits, etc.

Circle **Item 503** on Inquiry Card

Hydraulic Cylinders

Mo-Bar Hydraulics Co., Crystal Lake, Ill. Bulletin No. 203 giving a description of the company's Series "M" (medium-pressure) 500- to 2000-psi, 1 1/2- to 14-inch bore hydraulic cylinders. Included is information on mounting styles and accessories.

Circle **Item 504** on Inquiry Card

Numerically Controlled Lathes

R. K. LeBlond Machine Tool Co., Cincinnati, Ohio. Bulletin containing data on LeBlond "Tape-Turn" lathes, which have headstocks and carriages designed to accept commands from a General Electric Mark Century solid-state numerical-control system.

Circle **Item 505** on Inquiry Card

Plain Grinders

Landis Tool Co., Waynesboro, Pa. Bulletin 10RP-60 covering the 10-inch Type R and 14-inch Type LR plain cylindrical grinders. The new Type R features, condensed specifications, standard equipment, and equipment at extra cost are listed.

Circle **Item 506** on Inquiry Card

Chucking Machine

Brown & Sharpe Mfg. Co., Providence, R. I. Bulletin SM45 describing the B&S No. 2 automatic chucking machine, designed for facing, forming, turning, drilling, and threading operations. Round, square, hex, or irregular-shaped parts can be handled.

Circle **Item 507** on Inquiry Card

Rotary Compressor

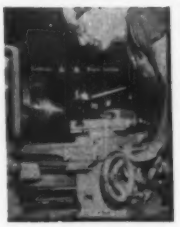
Fairbanks, Morse & Co., Chicago, Ill. Bulletin No. ACO 100.4 giving details on a heavy-duty rotary compressor for general-purpose services, including those requiring delivery of oil-free air, gas, or vapor. Performance coverage is listed.

Circle **Item 508** on Inquiry Card

Abrasive-Belt Grinder

Eastern Machine Screw Corporation, New Haven, Conn. Catalogue No. 100 on the Loungway rise-and-fall abrasive-belt grinder. Examples of parts produced are given, including items requiring intermittent ground surfaces, fillets, and difficult contours.

Circle **Item 509** on Inquiry Card



Engine Lathes

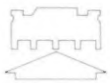
R. K. LeBlond Machine Tool Co., Cincinnati, Ohio. Bulletin No. R-215 presenting Regal engine lathes. The forces of turning that every lathe must withstand to maintain its accuracy, and how Regal design features negate these forces, are discussed.

Circle **Item 510** on Inquiry Card

When you think of PRECISION

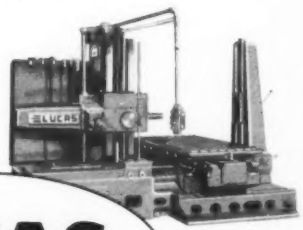
For life time precision Lucas provides

airlift to saddle

and table. 

These elements are supported on a thin film of lubricated compressed air during traverse. This separation of metal from metal virtually eliminates wear. During machining cycles the saddle and table are automatically clamped down tight to provide absolute rigidity for even the heaviest cuts. Unclamping is automatic, too. These are two aspects of Lucas design which contribute to the precision of these machines. Lucas Machine Division, The New Britain Machine Company, 12302 Kirby Avenue, Cleveland, Ohio. When you think of Precision . . .

think of . . .



LUCAS
PRECISION

When you think of RELIABILITY

Lucas automatic power positioning

automatically repeats

automatically repeats

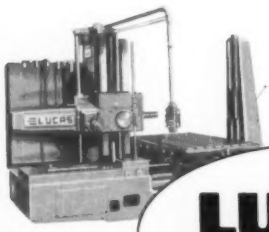
automatically repeats

to ±.0001 . . .

A simple, completely reliable system of dial indicators, end measures, and electrical controls automatically disengages rapid traverse, engages the fixed, constant-rate power feed and precision stops the unit at predetermined settings. Automatic power positioning assures the highest order of repetitive accuracy with an absolute minimum of operator attention.

A new catalog describes our complete line of horizontal boring, drilling and milling machines. Write Lucas Machine Division, The New Britain Machine Company, 12302 Kirby Avenue, Cleveland, Ohio. When you think of Reliability . . .

think of . . .



LUCAS
PRECISION

• Yours for the asking . . . use postcard inside back cover

Vertical Turners

Motch & Merryweather Machinery Co., Cleveland, Ohio. Catalogue No. VT-123 giving details on the firm's vertical turners, in which a group of standard components is assembled for turning, boring, facing, grooving, chamfering, and other operations.

Circle **Item 511** on Inquiry Card

Plastic Die Steels

Vanadium-Alloys Steel Co., Latrobe, Pa. Brochure on the properties and selection of plastic die steels, including grade characteristics of Vanadium-Alloys' family of steels useful for plastic-mold applications and a table of mold properties.

Circle **Item 512** on Inquiry Card

Barrel Finishing

Norton Co., Worcester, Mass. Form 501 containing descriptions of the various barrel-finishing processes, recommendations of the different abrasive shapes and sizes for applications in which they are best suited, case histories of actual uses, etc.

Circle **Item 513** on Inquiry Card

Die Castings

Hadlock & Temte, Inc., Chicago, Ill. Brochure giving data on the company's development in precision miniature die casting. Included are photographs of actual miniature parts produced to military standards and a list of advantages of the technique.

Circle **Item 514** on Inquiry Card

Welding Stainless Steel

Lincoln Electric Co., Cleveland, Ohio. Bulletin 7300.2 covering techniques for welding stainless steel. Physical properties, structure, and welding characteristics; deposit properties; and electrode recommendation tables are included.

Circle **Item 515** on Inquiry Card

Drilling Machines

Avey Division, Motch & Merryweather Machinery Co., Cincinnati, Ohio. Bulletin No. 460 describing six- and eight-spindle turret drilling machines. Details include preselective speeds and feeds, automatic or tape controls, variety of table sizes, etc.

Circle **Item 516** on Inquiry Card

Jig and Fixture Components

Jergens Tool Specialty Co., Cleveland, Ohio. Catalogue, entitled *How 80 Per Cent of American Companies Can Save Tooling Costs,* containing a chart and table comparing the costs of Jergens tools and those of "special" jigs and fixtures.

Circle **Item 517** on Inquiry Card

Saws and Tools

Victory Carbide Saw & Tool Co., Antioch, Ill. Catalogue listing the firm's complete line of carbide-tipped blades and tools. Included are standard blades, as well as M-20 metal-cutting, BT-45 all-purpose, 3 and 1 trim, and PC Penta-Cut types.

Circle **Item 518** on Inquiry Card

Drill Grinder

Farrel-Birmingham Co., Inc., Rochester, N. Y. Bulletin 4000-A describing the Farrel-Sellers 4-G drill grinder, which has a maximum capacity for two- and four-lip drills up to 3 inches in diameter and three-lip drills up to 2 9/16 inches in diameter.

Circle **Item 519** on Inquiry Card

Turret Drill

Fosdick Machine Tool Co., Cincinnati, Ohio. Bulletin No. FTD-1 featuring the Fosmatic numerically controlled turret drill. Thirty-two spindles in a revolving turret hold enough tools for hundreds of drilling, tapping, and milling operations.

Circle **Item 520** on Inquiry Card

Sanding and Polishing Machines

Curtis Machine Division of Carborundum Co., Niagara Falls, N. Y. Brochure on the 150 series abrasive-belt machines for woodworking and metalworking industries. Work-pieces 1/20 to 3 inches thick and up to 49 inches wide are handled.

Circle **Item 521** on Inquiry Card

Fractional-Horsepower Motor

Reliance Electric & Engineering Co., Cleveland, Ohio. Bulletin B-2514 giving construction and design details on the fractional-horsepower (1/20- through 3/4-hp) "Duty Master" motor. Features include a new ventilation system and reduction in weight.

Circle **Item 522** on Inquiry Card

• Yours for the asking . . . use postcard inside back cover

Cylindrical Grinders

Landis Tool Co., Waynesboro, Pa. Catalogue CG-60 on the company's precision cylindrical grinders. Universal, plain, roll, centerless, and single-purpose grinders are included, along with a description of the Microsphere wheel-spindle bearing.

Circle **Item 523** on Inquiry Card

Specifications

Bray Oil Co., Los Angeles, Calif. Military specification catalogue containing a list of references on over 450 specifications for users of products in the fields of lubrication, hydraulics, corrosion prevention, and similar specialized areas.

Circle **Item 529** on Inquiry Card

Presses, Clutches, and Feeds

Benchmaster, Gardena, Calif. Catalogue No. 601 covering punch presses; air and electromagnetic clutches; dial-index, motorized automatic, and automatic precision roll feeds; straightening machines; Koil Kradles; and bench milling machines.

Circle **Item 524** on Inquiry Card

Hydraulic Cylinders

Mo-Bar Hydraulics Co., Crystal Lake, Ill. Bulletin No. 204 containing data on the Series "H" (high-pressure) 2000- to 3000-psi, 1 1/2- to 12-inch bore hydraulic cylinders. Piston rod-end styles and accessories, such as mounting brackets, are described.

Circle **Item 530** on Inquiry Card

Welder Operation

Federal Machine & Welder Co., Warren, Ohio. Brochure 1-60 providing suggestions on operation and maintenance of Federal welders. Installation and setups, maintenance and lubrication, cleaning, servicing of electronic controls, etc., are covered.

Circle **Item 525** on Inquiry Card

Severe-Application Materials

Carborundum Co., Niagara Falls, N. Y. Pamphlet on twelve new materials which offer opportunities for improved design and performance in applications requiring resistance to abrasion, chemicals, corrosion, nuclear radiation, and high temperatures.

Circle **Item 531** on Inquiry Card

Contour-Milling Machines

Giddings & Lewis Machine Tool Co., Fond du Lac, Wis. Catalogue No. DM-115 featuring data on numerically controlled horizontal die-sinking and contour-milling machines. Construction and control features, optional equipment, etc., are presented.

Circle **Item 526** on Inquiry Card

Retaining Rings

Industrial Retaining Ring Co., Irvington, N. J. Catalogue No. 30 on the Series 3000 prestacked interval retaining rings. Available in 0.250- to 1.375-inch sizes, they are claimed to save time, permit automation, and simplify inventory control.

Circle **Item 532** on Inquiry Card

Cutting Fluids and Lubricants

Shear-Speed Chemical Products, division of Michigan Tool Co., Detroit, Mich. Catalogue covering twenty-six types of cutting fluids and lubricants. Physical and chemical properties and typical uses of each are conveniently tabulated.

Circle **Item 527** on Inquiry Card

Thread Grinder

Jones & Lamson Machine Co., Springfield, Vt. Brochure presenting data on the J&L Model 410 thread grinder, which is designed for small-lot production. Such features as prepacked work and wheel spindles are described. Specifications are given.

Circle **Item 533** on Inquiry Card

Cutter Guards

Royal Design & Mfg., Inc., Warren, Mich. Catalogue covering the firm's Cy-Co-Trol cutter guards. Also described are numerous safety features, such as coated handles or holders, locking clamp, and side or vertical guard for ease in storing.

Circle **Item 528** on Inquiry Card

Production Parts

Lincoln Engineering Co., St. Louis, Mo. Bulletin 921 describing frequently used production parts in original-equipment design. Included are specifications on such products as adapter couplings, bushings, elbows, tees, hose assemblies, and brackets.

Circle **Item 534** on Inquiry Card

9 questions you should ask about numerical machine tool controls

1

Has the system, through actual use, proven to be a money saver?

Many new controls on the market today have yet to be installed on their first customer application. However, Hughes numerical positioning controls have been successfully operating in customer plants for over a year and a half! One typical Hughes customer was able to cut tool costs by $3000 and reduce lead time by 50% on a run of 50 missile parts.

2

Is it competitively priced?

Many people are surprised that Hughes systems, with all their advantages, are often priced lower than competitive units.

3

How many machine axes can I control?

Hughes provides either two or three axis controls – in the same cabinet. And, with the Hughes system, you can purchase a two axis control now, and add the third later.

4

Are special skills required to prepare the tapes and operate the machine?

Not with the Hughes system. Anyone familiar with general machine shop practices can prepare the tapes and operate the machine after only two days training!

5

Can I get high accuracy – and, is that accuracy repeatable?

Hughes two-axis controls offer you repeatable accuracies of ±0.0002 inch with a resolution of ±0.001 inch. Adding the third axis, repeatable depth accuracies of ±.0005 with a resolution of ±0.001 inch can be obtained.

6

Will I need a great deal of service after sale?

Maybe you've heard about numerical control systems that require a lot of service. Not so when you specify a Hughes Numerical Machine Tool Control. Customers report that "up time" is over 95% – after a full year of operation!

7

Is the system transistorized for maximum reliability?

The Hughes Transistorized System is much less sensitive to vibration, shock and temperature fluctuation. Result: with Hughes transistorized circuitry you get higher reliability and minimum maintenance.

8

Is the tape reader fast and reliable?

Mechanical tape readers have two inherent disadvantages: they are relatively slow and they tend to deform the tape holes. Not so with photo electric tape readers – the type used on Hughes controls. They're extremely fast (eliminating need for costly electronic storage) and they do not injure the program tape.

9

Does the manufacturer have a reputation for standing behind everything sold?

Hughes gets an emphatic "yes" to this question. Hughes has built a reputation as a *world leader* in advanced electronics and has a world wide service organization.

Find out more about how Hughes Numerical Controls

can increase your profits. Write, wire, teletype (TWX INGL 4117) or call direct: Hughes Industrial Control Systems, Dept. No. 92-21, P.O. Box 90904, Los Angeles 45, California. For export information please write: Hughes International, Culver City, California.

CREATING A NEW WORLD WITH ELECTRONICS

HUGHES

HUGHES AIRCRAFT COMPANY
INDUSTRIAL SYSTEMS DIVISION

For more data circle this page number on card at back of book

• Yours for the asking . . . use postcard inside back cover

Milling Machines

Cincinnati Milling Machine Co., Cincinnati, Ohio. Catalogue No. M-2165 describing a 28-inch vertical Hydro-Tel milling machine. It is adaptable for general-purpose manually controlled milling, die-sinking, automatic profile-milling, etc.

Circle **Item 535** on Inquiry Card

Jig Borers

Fosdick Machine Tool Co., Cincinnati, Ohio. Brochure providing a description of two jig borers—Models 44 and 54—which can be equipped with tape control in three axes, giving them full numerical depth control and positioning control.

Circle **Item 541** on Inquiry Card

Numerically Controlled Machines

Sundstrand Machine Tool, division of Sundstrand Corporation, Belvidere, Ill. Bulletin covering the firm's numerically controlled machine tools. Turret, single-spindle rail, and horizontal type machines, in addition to the Omnimil, are described.

Circle **Item 536** on Inquiry Card

Socket Jam Screws

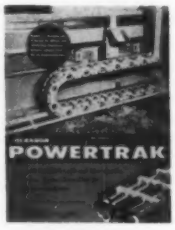
Holo-Krome Screw Corporation, Hartford, Conn. Catalogue (Form JS-1961) covering socket jam screws. The unique feature of this concept is the clear-through hexagon socket. It is accessible from either end, permitting fast, easy assembly.

Circle **Item 542** on Inquiry Card

Drill Sharpener

Connecticut Special Machine, Inc., Winsted, Conn. Brochure providing details on the company's Ampak electrolytic H.S.S. drill sharpener. Featured is a description of the Power Pak variable 1- to 8-volt, 300-ampere direct-current power converter.

Circle **Item 537** on Inquiry Card



Cable and Hose Carrier

Gleason Reel Corporation, Milwaukee, Wis. Bulletin giving details on the Powertrak multiple cable and hose carrier for conveying electric power, oil, air, water, and gases to point of application on equipment in motion. Diagrams are included.

Circle **Item 543** on Inquiry Card

Cold Forgings

Cold Forged Products Co., Detroit, Mich. Brochure illustrating parts made by the company's cold-extrusion process. Shafts, studs, hex bolts, pins and screws, and drive pinions are featured, along with a list of advantages of the process.

Circle **Item 538** on Inquiry Card

Limit Switches

General Electric Co., Schenectady, N. Y. Bulletin GEA-7312 on a line of lever, rotating-cam, and leverless limit switches for automatic pilot control. Included are application, selection, and installation guides, and a section on terminology.

Circle **Item 544** on Inquiry Card

Blades and Reamers

Ohio Knife Co., Cincinnati, Ohio. Bulletin covering blades and tools for all types of centerless grinders and screw machines. Included are the Rogers adjustable hand reamers and machine reamers and blades. Specifications and dimensions are provided.

Circle **Item 539** on Inquiry Card

Valve Taps

Landis Machine Co., Waynesboro, Pa. Bulletin G-102 containing information, diagrams, and charts on Landis stationary and rotary valve taps. Each tap body can be equipped with various heads to provide wide-range coverage with minimum tooling.

Circle **Item 545** on Inquiry Card

Positioning Device

Hanna Engineering Works, Chicago, Ill. Bulletin 500A presenting the electrical/mechanical Hanna-Powr positioner, which can automatically position many types of mechanical devices regulating machine tools, valves, floats, doors, etc.

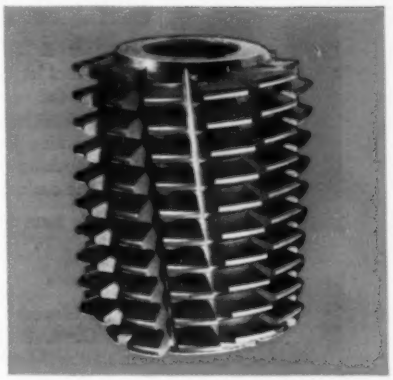
Circle **Item 540** on Inquiry Card

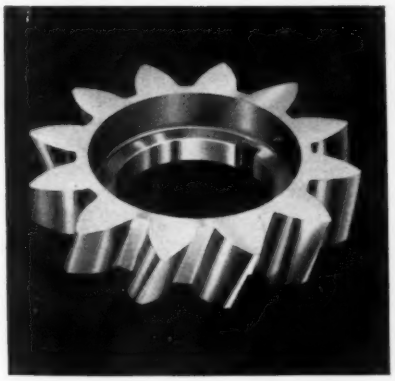
Turret Lathe

Jones & Lamson Machine Co., Springfield, Vt. Catalogue describing an automatic turret lathe for both bar and chuck work. The lathe features complete programming of all machine functions from a single staging panel mounted on the machine.

Circle **Item 546** on Inquiry Card

the more gears you cut, the greater your need for job-tailored Illinite® hobs and shaper cutters!





Increased costs and capacities of modern mass-production machines impose performance responsibilities which all-purpose tools were never intended to meet. That's why more and more volume gear-makers are protecting their capital investments with *job-tailored* Illinite hobs and shaper cutters.

Whether mass-produced gears are standards or specials, you'll get better work at lower costs with designed-for-you Illinite gear cutting tools – the specific-purpose hobs and shaper cutters that turn out consistent, economical accuracy. ***They're developed and made to do one job best—and this means long life, top output, low rejects.***

For nearly 50 years, Illinois Tool Works has helped gear makers solve troublesome problems through improved gear geometry, superior metallurgy, and precise inspections for accuracy. Experienced ITW field engineers will be glad to study your production facilities as well as end-use requirements, and submit cost-cutting recommendations.

ILLINOIS TOOL WORKS
TOOL & INSTRUMENT DIVISION
2501 N. KEELER AVENUE • CHICAGO 39, ILLINOIS

Write for these two informative handbooks, "Faster Gear Production" and "Know Your Shaper Cutters" —two "musts" for your technical library. Do it now before you forget.

• Yours for the asking . . . use postcard inside back cover

Chucking-Automatic Applications

Warner & Swasey Co., Cleveland, Ohio. Booklet presenting application ideas for the company's line of single-spindle chucking automatics. Described are machining jobs on 1AC, 2AC, and 3AC chucking automatics in shops across the nation.

Circle **Item 547** on Inquiry Card

Blast-Cleaning Barrels

Pangborn Corporation, Hagerstown, Md. Bulletin No. 705 covering five heavy-duty Rotoblast barrels with work capacities ranging from 15 to 102 cubic feet. Cutaway drawings, specifications, dimensions, and case histories are presented.

Circle **Item 553** on Inquiry Card

Micrometers

J. T. Slocomb Co., South Glastonbury, Conn. Bulletin No. 11 on the firm's direct-reading micrometer, the Speedmike, and the snap-gage micrometer. Information on optional features and optional terminals available is also included.

Circle **Item 548** on Inquiry Card

Drilling Machine

Giddings & Lewis Machine Tool Co., Fond du Lac, Wis. Bulletin BU-30 presenting the 10-hp Bickford 30-inch upright drilling machine with a radial-drill type head. Discussed are automatic electric tapping reverse, magnetic clutch, etc.

Circle **Item 554** on Inquiry Card

Couplings

Falk Corporation, Milwaukee, Wis. Bulletin 4100 presenting information on the firm's complete line of torsionally resilient Steelflex couplings. Additional coupling types, dimensions for larger sizes, and easier methods of selection are covered.

Circle **Item 549** on Inquiry Card

Industrial Fasteners

Standard Pressed Steel Co., Jenkintown, Pa. Catalogue (Form 2449) providing details on SPS's line of standard precision industrial fasteners, including socket-screw products, pressure plugs, lock-nuts, spring pins, dowel-pins, and steel collars.

Circle **Item 555** on Inquiry Card

Welding Positioner

Airline Welding & Engineering, Gardena, Calif. Bulletin AW-11-60 covering the company's Series 11300 basic longitudinal welding positioner, which can be tooled with standard Airline accessories for production welding of thin-gage foil or plate.

Circle **Item 550** on Inquiry Card

Clamps and Vises

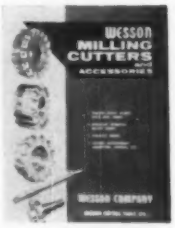
Universal Vise & Tool Co., Parma, Mich. Catalogue No. 1161CJ describing the company's tools, including the Speedi-Spacer and "B" series clamps, as well as Universal's machine vises, rotary tables, and other work-holding and positioning devices.

Circle **Item 556** on Inquiry Card

Air Gage

Taft-Peirce Mfg. Co., Woonsocket, R. I. Catalogue No. 615 presenting the CompAIRator air gage. Also included are descriptions of air plug, ring, and snap gages; air capsules; the CompUtair air-gaging circuit; and CompAIRamatic control units.

Circle **Item 551** on Inquiry Card



Milling Cutters

Wesson Co., Ferndale, Mich. Catalogue No. M-860 giving specifications on the Wesson lines of throw-away and conventional carbide milling cutters, accessories, blades, parts, and tools. Included are Rigidcut and Varicut inserted-blade cutters.

Circle **Item 557** on Inquiry Card

Turret Lathe

Rivett Lathe & Grinder, Inc., Boston, Mass. Bulletin 60T giving details on the Rivett 60 series precision turret lathe. Highlighted are six Rivett "firsts," with particular emphasis on the new "One Motion Control," and an automatic indexing turret.

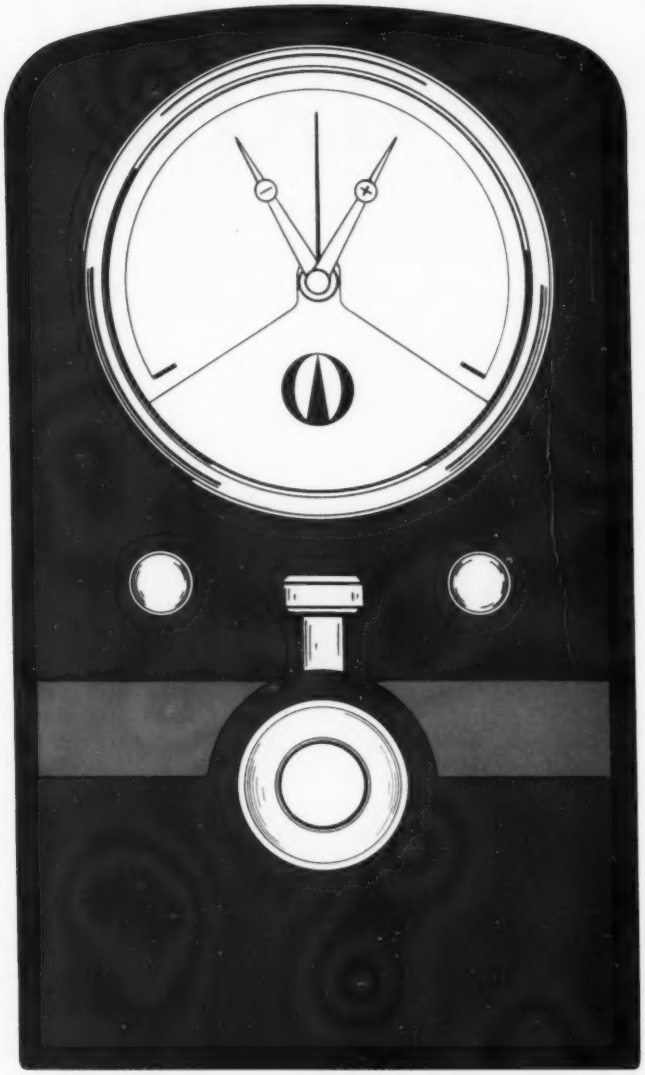
Circle **Item 552** on Inquiry Card

Positioning Machine

Micro-Path, Inc., a subsidiary of United Industrial Corporation, Los Angeles, Calif. Bulletin 602 on the Model 440 "Optical Programmer," a positioning machine with magnetic-tape control for point-to-point and continuous-path operation.

Circle **Item 558** on Inquiry Card

ON ZERO—



STANDARD'S NEW LINE OF AIR GAGES — FEATURES ADJUSTABLE MAGNIFICATION

With Model #120, recommended for all normal inspection tolerances, this portion of the dial

can represent any value from .0005" to .060" and, with Model #240, recommended for extremely precise inspection tolerances, this same portion of the dial

can represent any value from .0001" to .0005".

Each model offers a wide range of dial values and zero points; plus an extremely quick and effective "blow-down" for easy cleaning and maintenance of the Gaging Stands — all without need of tools, conversion parts, factory service or special operator skill.

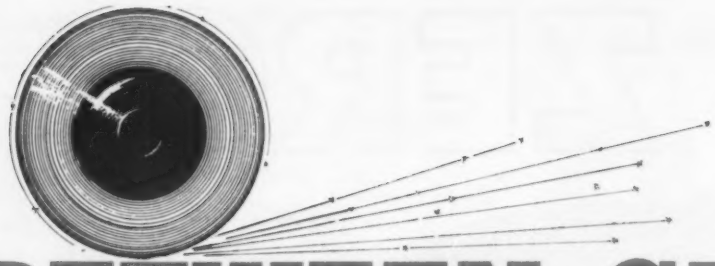
Among many economical advantages to the user is the fact that conventional air plugs and air rings, even from most other manufacturers, last longer and can do a greater variety of inspection jobs when used with STANDARD Air Gaging Stands.

For complete catalog and price list, or on-the-job demonstration in your own plant, write or phone your nearest representative or contact:

STANDARD GAGE COMPANY, INC.

POUGHKEEPSIE, N. Y. TELEPHONE GROVER 1-3100

For more data circle this page number on card at back of book



By E. S. Salichs

BETWEEN GRINDS

Great Gift

We were interested to learn that a Douglas Aircraft executive, Joseph N. Goesche, has donated to the library of the University of Southern California consecutive numbers of MACHINERY from 1940 through 1960, the file having been sought to bring the library up to date. Your generosity is appreciated, Mr. Goesche.

Basin Blues Just That

In the Caverns of Luray, Va., subterranean music stems from a "Stalacpipe"—an organ designed by Leland W. Sprinkle, Sr., an electronics engineer and pipe-organ student. Mr. Sprinkle selected certain formations of stalactites over a 3-acre area; then small threaded rods of Allegheny Ludlum alloy were bolted rigidly through the stalactites, close to tiny wire-wound magnets. When an electronically controlled hammer struck a stalactite so treated, the combination of rod and magnet became a tone generator. The organ console deriving its musical tones from the stalactites is located in the ballroom of the cavern. Shall we dance in the dungeon in our old dungarees?

The Dome Is Done

The United States Capitol Dome has been renovated after eighteen months' work, which involved installation of nearly 10,000 pounds of stainless-steel bolts, plates, flashing, and cables. This reinforcement will help the edifice withstand damage from corrosion, and from expansion and contraction due to temperature changes. Hot words and cool looks evidently contributed to wear on the dome, which dates back to 1865.

Heat It and Eat It

Cafeterias without kitchens will be possible in industrial plants by installing Radarange microwave ovens and ordering meals from outside commissaries. The employes can make selections from refrigerated display cases, pop their choice into these ovens, push buttons, wait sixty seconds, then sit down to a hot meal. All we hope is that the commissary cooks don't duplicate the TV dinners that the workers may get at home. ■

Engine Wins Horsepower Race

For years, according to *Steelways*, the goal of those who design internal combustion engines for automotive use has been to breed a 1-pound horse—an engine which for every pound of its own weight would generate 1 hp. Now it has been done. A California engineering company has just unveiled a 175-pound engine which generates 175 hp, the secret being an engine-block assembly made of thin stainless-steel sheet.

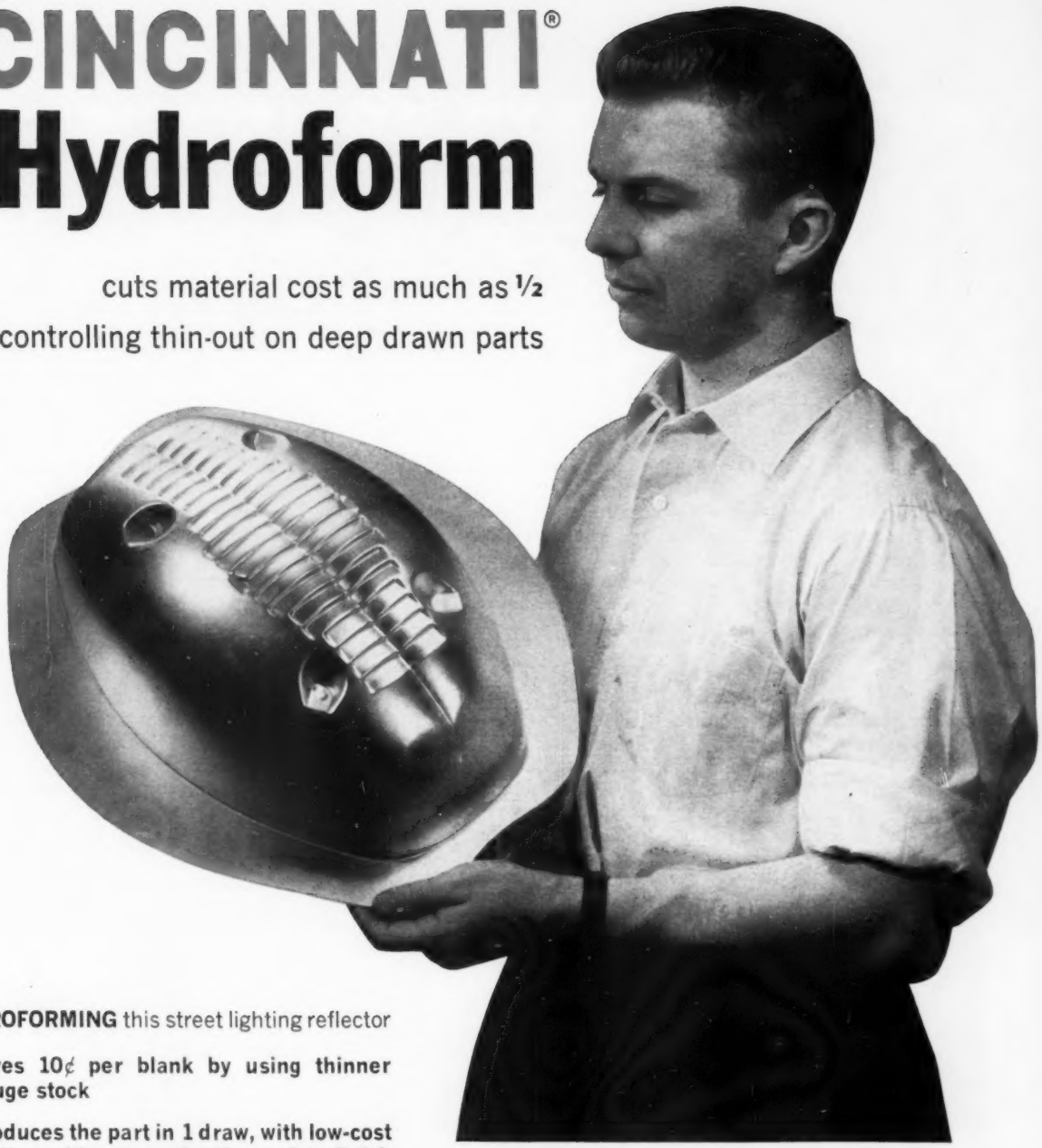
The Hat with a View

A welder may now open a window in his helmet simply by opening his mouth, if he is wearing the "Auto-View." To replace his leakproof light filter, he closes his mouth. Simple—and if he is the victim of adenoids or gum chewing, he may use the retainer button.

IN PROFITABLE PASTURE—Seen here are a few of the obsolete automatic screw machines returned to the Brown & Sharpe Foundry at Providence, R. I., from various parts of the country—the result of an offer made of a $500 trade-in allowance to companies in the United States owning old B&S automatic screw machines, regardless of age or condition. This program is a wonderful step toward modernizing screw machine departments, and we think the movement could be carried into other fields. We have some beat-up equipment at home we would just love to ship back to respective manufacturers for a consideration, like $500.

CINCINNATI® Hydroform

cuts material cost as much as ½
by controlling thin-out on deep drawn parts



HYDROFORMING this street lighting reflector

saves 10¢ per blank by using thinner gauge stock

produces the part in 1 draw, with low-cost tooling, without marring the surface finish of the pre-polished blank

reduces scrap loss from 5% to less than 1%

eliminates the embossing operation

improves reflection. Conventional methods could not reproduce the highly accurate reflector contours required. Hydroforming produces the part as it was designed.

Similar savings can be yours, with the Cincinnati Hydroform®. For detailed information, write direct, or call in a Meta-Dynamics Division application engineer.

META-DYNAMICS DIVISION

CINCINNATI

THE CINCINNATI MILLING MACHINE CO.
Cincinnati 9, Ohio

For more data circle this page number on card at back of book

(New Developments in Shop Equipment—Continued from Page 192)

Involute Checker for Spur or Helical Gears

The Michigan Tool Co., Detroit, Mich., is offering "Sine-Line" involute checkers in which settings are made optically. Angles can be set within 0.001 degree without the use of gage-blocks; thus this operation is independent of the operator's "touch." Checking accuracy is repetitive within 0.0001 inch. These instruments are used primarily to check the involute profile on spur or helical gears, but they can also be used to check tooth spacing.

The gear to be checked is mounted between centers and the indicator sensing probe is brought into contact with the involute contour. The indicator is set—through use of the optical system—so that its tip travels in a path tangent to the base circle. Movement of the indicator sensing probe, along line of action, and rotation of the gear are synchronized through the sine bar, so that for each degree of gear rotation, the indicator moves a distance equal to 1/360 of the circumference of the base circle of the gear.

Rapid checking for consistency of form on successive teeth is possible since such checks can be made on any point of the contour. Reading is direct from a graduated scale and a dial indicator that shows the amount of error in form. The Michigan Model MTR-16 transistorized recorder can be used where a permanent checking record is desired.

These checkers are based on the use of a sine bar to obtain the proper ratio between the single master disc and the base diameter of the gear being checked.

Model 1124 instruments will check gears with maximum diameters to 12 inches, and have a normal maximum center distance of 14 inches. Model 1124-C checkers will inspect gears with maximum diameters of 20 inches, and a center distance of 24 inches.

Circle 608 on Readers' Service Card

Minidekkor Auto-Collimator for Checking Machine Tool Setups

A small, lightweight Minidekkor auto-collimator for workshop and toolroom use is being introduced in this country by the Engis Equipment Co., Chicago, Ill. Applications of this instrument include the checking of machine tools and machine tool setups; V-blocks; fixtures, gages, and toolroom equipment; and angles on precision products such as plastic molds, dies, and fixtures. Angular displacements in two directions are measured simultaneously by comparison with a standard, such as a gage-block or polygon. The reading is obtained by observing in the eyepiece the position of a reflected cross-line target in relation to a fixed scale graduated in minutes. Readings can be taken direct to 1 minute of arc and estimated easily to 30 seconds.

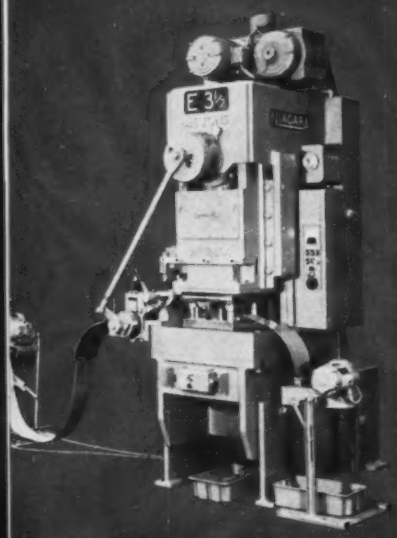
The recommended maximum working distance of this instrument is 12 feet. Maximum measuring range is 60 by 60 minutes of arc. Over-all length of the instrument is 6 inches, and the diameter of the telescope tube is 1 inch. The eyepiece can be at the end or at the side of the tube. The accompanying illustration shows the Minidekkor on the stand of an engineer's universal microscope, using an accessory mounting bracket.

Circle 609 on Readers' Service Card

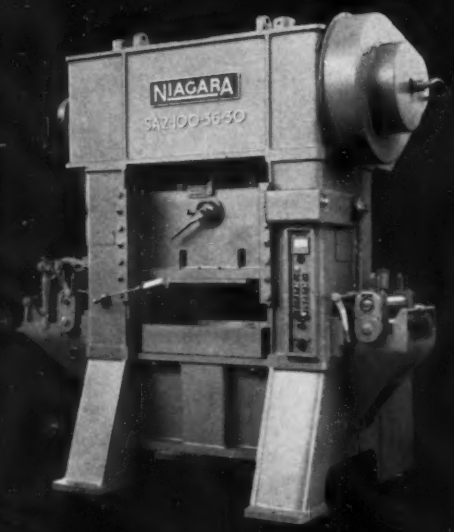
(Left) Michigan Model 1124 gear checker with optical system. (Right) Recorder for making inspection records

Auto-collimator for checking machine tools and machine tool setups introduced by the Engis Equipment Co.

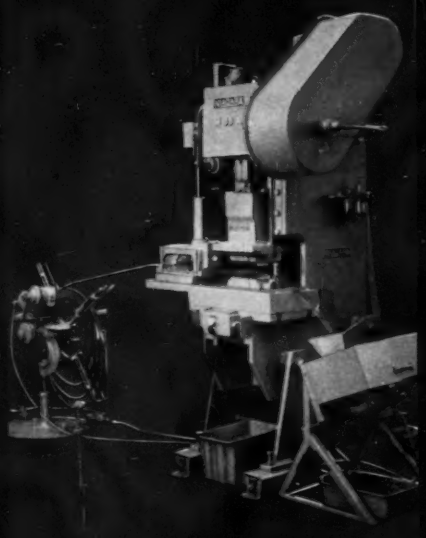
PRECISION PARTS BY THE MILLIONS



SERIES E — FRONT-TO-BACK CRANKSHAFT OBI's
Capacities: 45 to 200 tons.
45-ton model (above) stamps out fuse tips at rate of million/day.



SERIES SA-2 STRAIGHTSIDE AUTOMATICS
Capacities: 25 to 300 tons.
100-ton package (above) includes double roll feed, stock reel, scrap cutter.



SERIES M — ULTRA-HIGH SPEED OBI's
Capacities: 22 to 60 tons.
35-ton model shown operates at adjustable speeds up to 1000 spm and produces parts at rate of million/day.

3 great Niagara lines excel in automatic, high speed, progressive die work

Premium construction: It's the key to premium performance here! These modern Niagara presses are designed strictly for automatic, high speed, progressive die work.

Model for model, they'll turn out more parts per hour than conventional presses of equivalent tonnage can even approach. Far heavier and more massive, they have the ruggedness, rigidity, and stamina to run vibration-free at high speeds.

Providing more guiding surface, their gibbing holds slide and bed in precise alignment for precise production, longer periods between die grinds, and longest possible die life.

But this just begins to tell the story . . .

YOU'RE INVITED TO CHECK all the features of these production-boosting machines. Illustrated Bulletins 54 (Series M), 56 (Series E), and 264 (Series SA-2), will be mailed on request. Write: Niagara Machine & Tool Works, Buffalo 11, N.Y.

NIAGARA

America's most complete line of presses, press brakes, shears, other machines and tools for plate and sheet metal work.

Fig. 1. Tolerances on TSP slitter knives are electronically controlled by special attachment on Heald machine

Fig. 2. Checking parallelity on finished "Tool Steel Process" slitter knives, using a vernier height gage

Precision Automatic Grinder with Electronic Control for Processing Rotary Slitter Knives

Rotary TSP slitter knives designed and made for exceptional performance and economy by the Tool Steel Gear & Pinion Co., Cincinnati, Ohio, are now precision ground and finished on a new machine that electronically controls the knife tolerances.

The new machine, Fig. 1, is a 24-inch Heald precision automatic rotary surface grinder. An electronic spark-out attachment on the machine assures good finishes and accurate control for finish flat-grinding rotary slitter knives such as shown in Fig. 2. Tolerances are held to 0.0002 inch on both plane positioning and flatness. A finish of 6 to 10 micro-inches is obtained.

Circle 610 on Readers' Service Card

THESE BENEFITS ARE YOURS

when your drills are sharpened on

the Model 100-A

WINSLO-MATIC DRILL POINTER

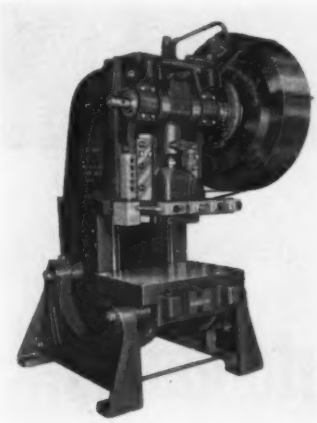
- ...extremely true, close-tolerance holes within .001 of drill size (even in the new super-metals) since drill points are concentric within .0002.
- ...precision conventional chisel type drill points as well as **helical** (self centering) drill points essential to optimum performance on **tape controlled** drilling machines.
- ...increased production from every drill because drills last up to twice as long.
- ...elimination of most reaming requirements.
- ...faster, more precision drilling with fewer rejects.

20" diameter grinding wheel

Get these benefits...and many more with the completely automatic WINSLO-MATIC DRILL POINTER. Handles drills from 1/32" to 1½" diameters.

Write for descriptive literature and check for yourself the many exclusive advantages of the versatile WINSLO-MATIC Drill Pointer.

Winslow PRODUCT ENGINEERING CORPORATION
47 ST. JOSEPH STREET • ARCADIA, CALIFORNIA



Press-Rite power press announced by Havir Mfg. Co.

"Press-Rite" Power Press

A 55-ton "Press-Rite" power press which combines fast operation and versatility of application in a ruggedly designed frame has been announced by Havir Mfg. Co., St. Paul, Minn. This press was designed to handle both large- and small-sized jobs easily and quickly. It features an extra-

WELD LIGHT GAUGE STEEL WITH AIRCO'S NEW AIRCOMATIC CO_2 GUN—THE AH 30-A

Want to do a production job on steel 3/16″ or less . . . economically . . . in any position . . . without edge preparation . . . no clean up and practically no spatter? Get the Aircomatic AH 30-A gun. • **Lower in price,** easier to handle, and more versatile than anything in its class, the Aircomatic AH 30-A is a nimble companion to the rugged AH 60-B gun. Its gooseneck nozzle gets it into the hard-to-reach places. Its expendable parts can be replaced with ease. Air-cooled — no plumbing! • **Wire feeder: any Airco type,** including the inexpensive AHF-D shown here. Wire sizes: the popular .035″-.045″ diameters. Gases: argon, argon-O_2 mixtures, money-saving CO_2 from the Pure Carbonic Co., and argon-CO_2 mixture. Rating: 300 amps DCRP CO_2 buried arc or 200 amps DCRP spray transfer.

• **Airco produces the industry's most complete line** of manual and automatic gas-shielded arc welding equipment: welding heads . . . holders . . . guns . . . wire . . . wire feeders . . . welding machines . . . gases . . . accessories. To profit most, whatever you weld, make use of Airco experience. Look for your nearest Authorized Airco Distributor in your Classified Telephone Directory under "Welding Equipment & Supplies" or call your local Airco office.

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AIR REDUCTION SALES COMPANY

A division of Air Reduction Company, Incorporated

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More than 700 Authorized Airco Distributors Coast to Coast

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heavy and fast-operating ram slide with long, full vee ram designed to maintain precision alignment under loads.

Full lubrication during fast operation is insured on the front and rear ways of this press when in an upright or inclined position. In addition to fast operation, the press features a ram with extra-large area for handling heavy-duty jobs as well as small ones. The ram also has a special steel removable bushing in the die-shank hole in the slide.

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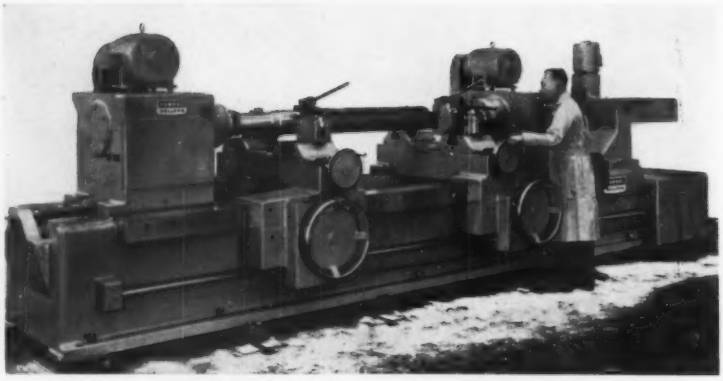

Farrel-Sellers journal-truing and axle lathe

INSPECTION PROJECTOR MAGNIFIES FOR ® QUALITY...

Our inspection projector magnifies cutting edges to eliminate the minute angular deflection that could cause you costly production losses . . . just one of many inspections that account for Circle R quality.

CIRCLE R saws, slitters and combination center drills must submit to constant exhaustive inspection to work their way to you. They've got to prove they can ensure you correct cutting angles, long service, and minimal downtime.

Consult these CIRCLE R *Specialists . . .*

BURBANK — Production Mach. Sales Inc.
CEDAR RAPIDS — McNeel Tool & Supply Corp.
CHICAGO — Donald Robertson & Co.
CLEVELAND — Production Tool Co.
DAYTON — J. R. Davis Company
DETROIT — J. L. Bradford Associates
HACKENSACK — The Eaton Company
INDIANAPOLIS — Donald McIntire
MEMPHIS — Branch-Morrow Tool Specialists
MILWAUKEE — Ford Tool Company
MONTREAL — Humphrey B. Walton
NEW HYDE PARK — The Eaton Company
NEW YORK CITY — J. V. Cremonie (Export)
PHILADELPHIA — General Tool Sales Co.
PHOENIX — Di-Eugenio Tool Center
PITTSBURGH — Ralph Esposito & Co.
PROVIDENCE — Fred J. McMillan
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CIRCULAR TOOL CO., INC.
PROVIDENCE 5, RHODE ISLAND
Specialists in Circular Cutting Tools Since 1923

METAL SLITTING SAWS • COPPER SLITTING SAWS • SCREW SLOTTING SAWS • COMMUTATOR SLOTTING SAWS • JEWELERS' SLOTTING SAWS • CUT OFF SAWS • CIRCULAR KNIVES & ROTARY SHEAR BLADES • CIRCOLOY STEEL SAWS • SOLID & TIPPED TUNGSTEN CARBIDE SAWS • COMBINED DRILLS & COUNTERSINKS • CENTER REAMERS

Dual End-Drive Journal-Truing and Axle Lathe

A Farrel-Sellers lathe designed to turn the journals, wheel seats, collars, and dust-guard seats and burnish the journals, collars, and dust-guard seats of new and used A.A.R. standard car or diesel axles has been announced by the Farrel-Birmingham Co., Inc., Consolidated Machine Tool Division, Rochester, N. Y. This lathe will also perform truing and burnishing operations on journals and end collars on mounted car-wheel sets having up to and including 46-inch tread diameter wheels. By employing both carriages, the lathe will perform the following functions: rough-turn, finish-turn, and burnish either new or used car or diesel axles in standard A.A.R. sizes from 3 3/4 by 7 inches up to and including 6 1/2 by 12 inches; turn and burnish inside journals of mounted wheel sets with tread diameters up to 46 inches; and turn center portion, between wheel seats, of either straight or tapered axles.

Some of the outstanding features of this new lathe are: dual end drive; infinite feed increments through a rheostat; and feed increments that are adjustable while cutting. Push-button chucking does not require the tightening and locking of spindle centers.

The lathe has a swing over the bed of 49 inches which accommodates a wheel-tread diameter of 46 inches. Bed length is 17 feet 8 inches, and the depth is 28 inches. The center height is 46 3/4 inches from the floor line.

Circle 612 on Readers' Service Card

Unique Multiple-Spindle Drill Head

A unique type of multiple-spindle drill head is now being offered by the United States Drill Head Co., Cincinnati, Ohio. Called the Adjustafix, this new head is actually a fixed-center type which can be easily changed to different hole patterns. It is readily installed on standard or special machines now in use, and affords great flexibility for drilling, tapping, reaming, spot-facing, boring, counterboring, and milling operations.

The basic design provides a main-drive box and a demountable pattern plate. A complete engineering change-over may be quickly made, leaving as much as 90 per cent of the head intact. When shifting to another job, only the pattern plate is changed, and the spindles and idlers are relocated on the new pattern plate to conform to the new design. And, because spindle and idler construction are entirely separate self-contained assemblies, exact tool speed required for a given job is obtained without any change of gearing in the main-drive box.

Various types of lubrication are available—oil mist, automatic oil with pump, oil splash, or grease lubrication.

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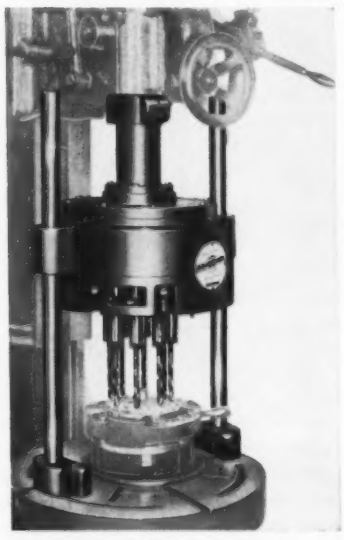


Adjustafix drill head equipped with guide-bar mountings on a standard drill press

HOW TO EXPAND THE USE OF YOUR PRESS BRAKES

the blue book of press brake tooling

This new book is the most comprehensive treatise on press brake work—134 pages of ideas. It is offered to assist press brake users visualize methods suitable to their own bending and forming needs.

To develop any of these ideas to your particular type of work, on any make of press brake, the Tooling Division at Dreis & Krump offers you top, experienced designers and a large die shop well equipped to make the finest press brake dies of any type, any size, at lowest cost.

This book, Press Brake Dies, is available to any press brake user by request on company letterhead.

9757

A Tradition of Quality and Value since 1899

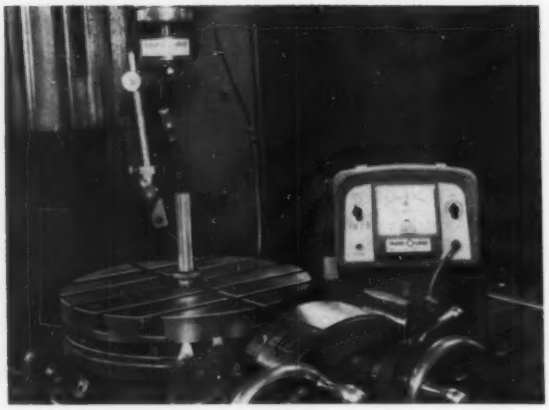
Press Brakes • Press Brake Dies
Hand and Power Bending Brakes
Special Metal-Forming Machines

CHICAGO DREIS & KRUMP

DREIS & KRUMP MANUFACTURING CO.
7412 S. Loomis Blvd., Chicago 36, Illinois

For more data circle this page number on card at back of book

Linde electronic governor for direct-current motors



P&W Trans-O-Limit centering gage and amplifier

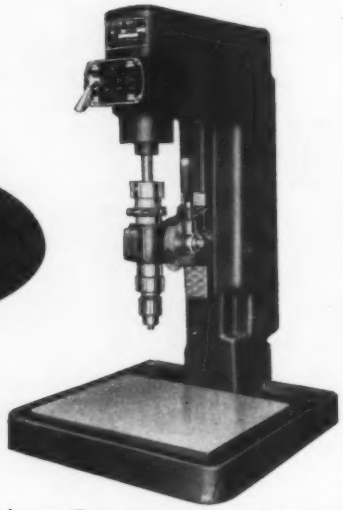
Electronic Governor for Direct-Current Motors

The Linde Company, division of Union Carbide Corporation, New York City, announces a new heavy-duty electronic governor for precise speed control of shunt-wound direct-current motors up to the 1 hp size.

The new governor maintains a constant motor speed at any selected value despite variations in load, line voltage or motor temperature. Operating from a 230-volt 50-60 cycle single-phase line, the unit is available either as a stripped chassis suitable for incorporation into other equipment, as a rack-mounted unit, or as a self-contained unit enclosed in a cabinet.

Circle 614 on Readers' Service Card

production drill
for precision holes



Let us show you how to knock hours off your production and precision drilling with this MA-8. Capacity to ⅜". Eight spindle speeds with 10:1 range (variable speeds optional). Hand feed or air hydraulic. 12" swing. Column or bench type. One to six of our famous precision spindles, which give you quiet, vibrationless speeds up to 12,000 rpm. Send for Bulletin 857 or phone us. Avey, Box 1264, Cincinnati 1, Ohio.

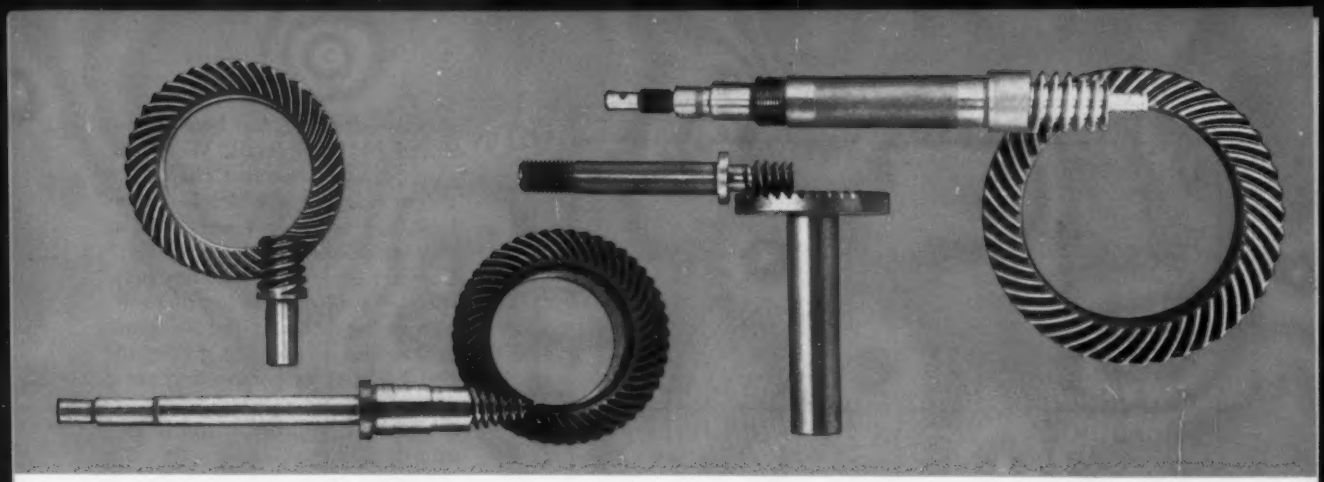
P & W Trans-O-Limit Centering Gage

A quick-responding, highly accurate gage for precise hole locating or centering from a machine tool spindle has been produced by the Pratt & Whitney Co., Inc., West Hartford, Conn. Known as the Trans-O-Limit centering gage, this device has an accuracy, including linearity and repeatability, of 1 per cent for the full scale, which is equal to 1/4 of one division on the scale.

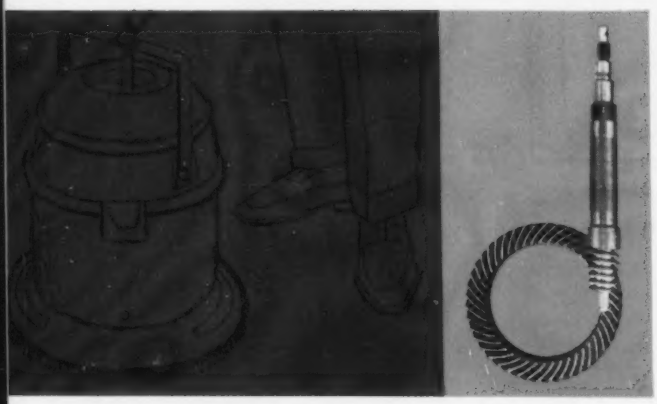
The centering gage has a radial capacity of 23 inches inside diameter and 19 inches outside diameter, and a depth capacity of 8 3/8 to 15 1/8 inches, depending on the configuration of the part. Basically the centering gage consists of a Trans-O-Limit height gage head, slip-ring assembly, gage-head support arm, and interchangeable arbors for different mountings. In addition, either of two instrument cabinets with different amplifiers will be furnished. One instrument cabinet has a four-way range switch providing magnifications of 0.0005, 0.001, 0.005, and 0.010 inch full scale. The second cabinet has a two-way switch to provide magnifications of 0.001 and 0.010 inch full scale.

The principal uses of the centering gage are: accurate positioning and aligning of work on machine table; checking of spindle runout; and measurement of holes, plugs, and bosses for squareness, taper, roundness, bellmouth, concentricity, and center-to-center distances.

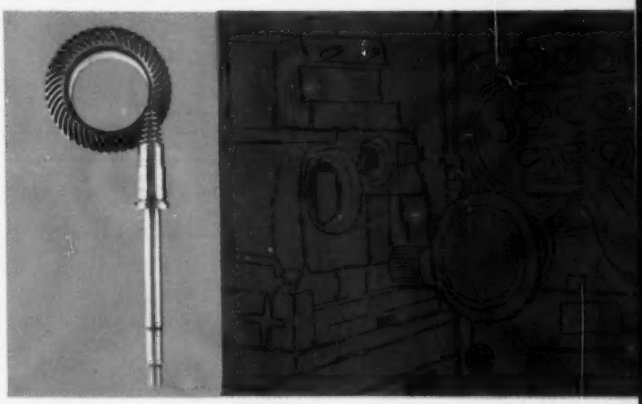
Circle 615 on Readers' Service Card



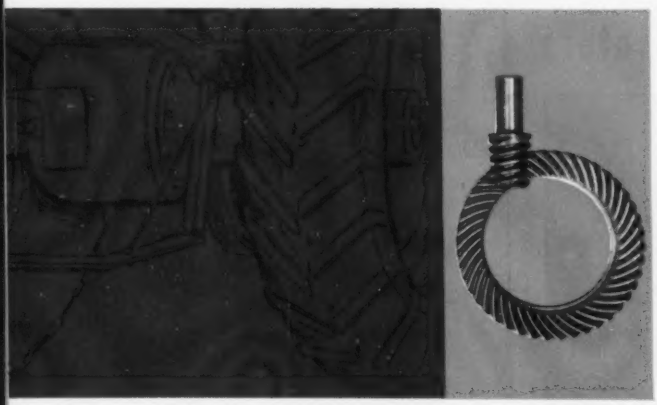
WHICH OF THESE HIGH-RATIO HYPOIDS IS "JUST RIGHT" FOR YOUR PRODUCT?



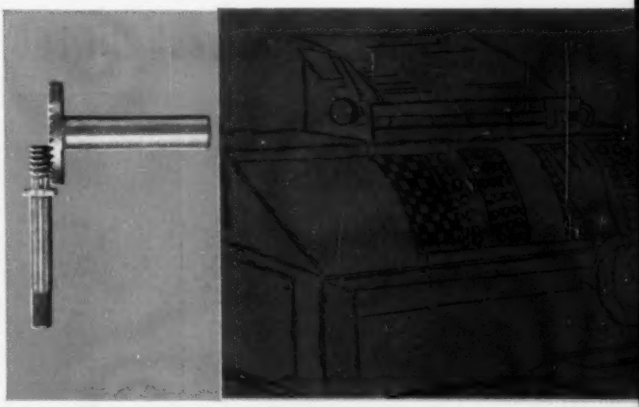
For hand tools. Where space is a problem—as in portable tools like this one—the high offset lets you design a more compact unit. Choose just the offset to solve your design problem with a more flexible, more compact unit than the corresponding worm and wheel.



. . . or machine tools. This high-offset pair lets you combine high reduction with strength, compactness and other advantages you might find profitable in designing machine tools. High-ratio hypoids can be produced on Gleason equipment for ratios of 1:10, 1:40 or even higher.



Big and strong. Where you need strength—as in farm machinery—high-offset hypoid pinions (with teeth which tend to "wrap around") are larger and stronger than corresponding bevel pinions. An extended shank on cylindrical pinions makes very rigid straddle mountings practical.

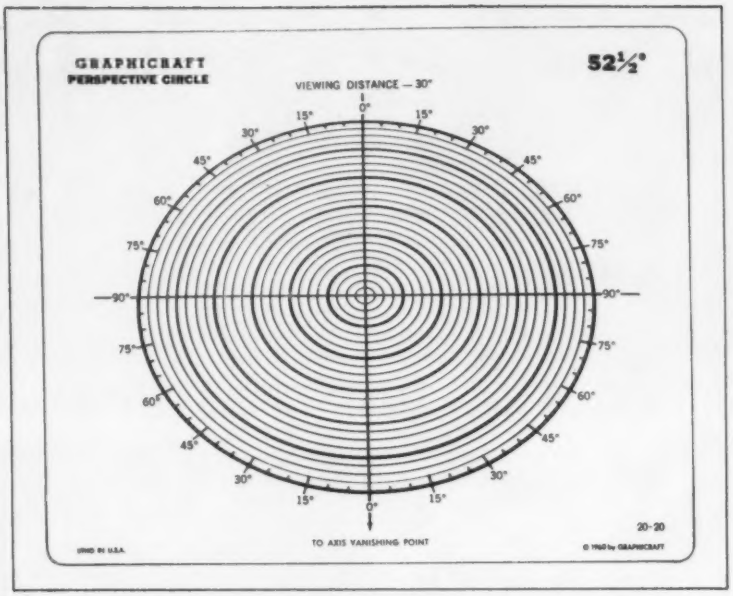


. . . or small and smooth. For smooth operation—as in office equipment that must run quietly—high-offset pairs provide smooth, quiet tooth action. Because teeth "wrap around" the pinion, you get continuous action—even with just one or two teeth! Grinders are available for applications requiring precision finish.

High-offset or high-ratio hypoids can be cut, tested, and quenched on the same Gleason equipment that is used on more familiar spiral bevel and hypoid gears. You can get more information about Gleason high-ratio hypoid gears by writing for free literature. Submit your prints for recommendations.

GLEASON WORKS

1000 UNIVERSITY AVE., ROCHESTER 3, N.Y.



One of a set of twenty-seven Graphicraft perspective-circle guide cards

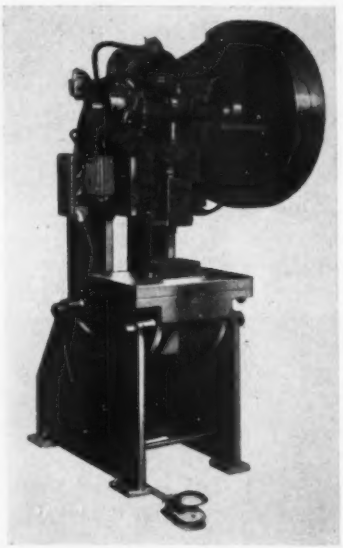
Perspective-Circle Guides for Making Perspective Drawings

A set of twenty-seven underlay guide cards showing perspective circles from 1/4 to 6 inches in diameter at viewing angles from 5 to 70 degrees, with 2 1/2-degree steps to give a gradual visual transition of the circle as it moves from one area to another in a perspective drawing, has been introduced by Graphicraft, Westport, Conn. The perspective circles on these cards, one of which is shown here, are precisely accurate at a viewing distance of 30 inches. They are compatible with any perspective grid or drawing of similar viewing distance. The 5-degree calibrations enable the guides to also be used as perspective protractors. The cards are made of heavy moistureproof bristol to assure durability.

Circle 616 on Readers' Service Card

Open-Back Inclinable Punch Press

An open-back inclinable punch press featuring a 30-ton capacity with 15 per cent overload safety factor has been added to the line manufactured by the Whitney Metal Tool Co., Rockford, Ill. This press has an all-welded, stress-relieved steel frame. Its pin type nonrepeat clutch is converted to repeat operation by turning a switch. The press is electrically operated at the rate of 120 strokes per minute. The opening through the back is 12 inches wide with an 8 1/2-inch throat depth and 12 1/2-inch throat height. The frame can be inclined at an angle of 30 degrees.



Whitney open-back inclinable press

A movable foot-trip, which can be placed where it is most con-

HOW TO DESIGN EXCESS WEAR
Out OF MACHINE TOOLS WITH
MADISON-KIPP Fresh Oil Lubricators

Machine Tools, Compressors and special machines of all kinds have been kept in top condition for 20 or 30 years or more when equipped with one of 6 models of Madison-Kipp Lubricators.

Fresh Oil Lubrication is automatic, closely measured, constantly fed new oil under pressure for each friction surface to which it is applied.

The Model OL—one of the 6 Models of Madison-Kipp Lubricators.

kipp

MADISON-KIPP CORPORATION
203 WAUBESA STREET • MADISON 10, WISCONSIN

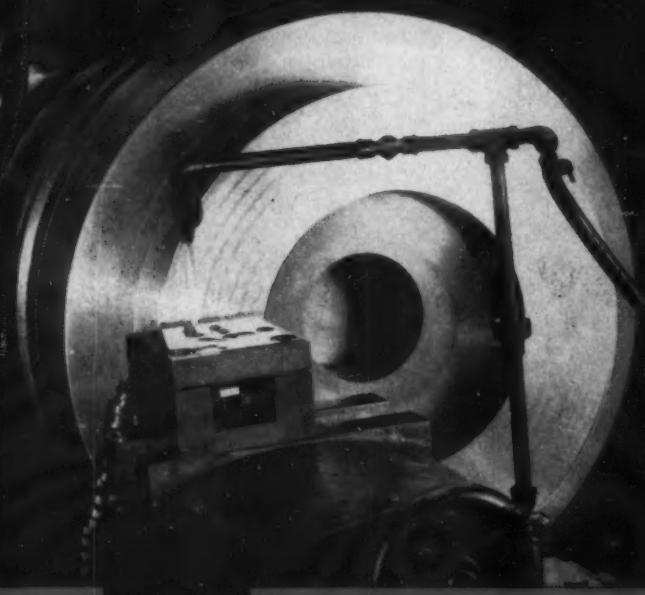
Skilled in Die Casting Mechanics • Experienced in Lubrication Engineering • Originators of Really High Speed Air Tools

*use Airpower–not Manpower**

CUSHMAN

AIR OPERATED CHUCKS AND CYLINDERS

* Cushman Air Operated Chucks speed production and improve product quality, eliminate fatiguing hand wrenching, plus related rejects and accidents.



SOLD THROUGH
INDUSTRIAL
DISTRIBUTORS

2CS61

Cushman also manufactures manually operated chucks, power wrenches, and face plate jaws.

THE CUSHMAN CHUCK COMPANY • HARTFORD 2, CONNECTICUT

venient for the operator, controls the press. The ram is held securely by vee type gibs for positive punch and die alignment. Length of stroke is 3 inches, and ram adjustment, 2 1/2 inches. Many special design features are available at slight extra cost, including automatic oilers, air-operated clutches, hand-operated trip-buttons, and other features. Punches and dies up to 6-inch rounds, as well as irregular shapes and special sets, are stocked.

Circle 617 on Readers' Service Card

Model 4 MD Wallace-Tubela extra-heavy pipe-bending machine

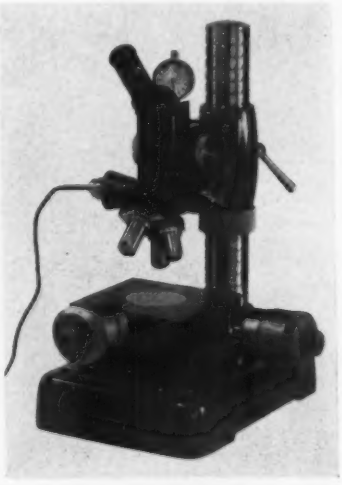
Wallace-Tubela Pipe-Bending Machine

A Model 4 MD pipe bender with a capacity for bending extra-heavy steel pipe up to 4 inches in diameter has been added to the Wallace-Tubela line introduced by the Wallace Supplies Mfg. Co., Chicago, Ill. Standard equipment includes 2 1/2-, 3-, 3 1/2- and 4-inch iron-pipe size dies. The net weight of this machine is 1187 pounds. Special dies can be had for bending channels and similar shapes.

Circle 618 on Readers' Service Card

Multiple-Purpose Measuring Microscope

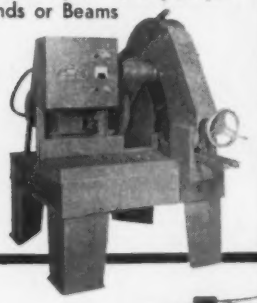
A multiple-purpose microscope—called the Optotron—which combines a coordinate measuring, a toolmaker, and a metallurgical microscope in one compact and



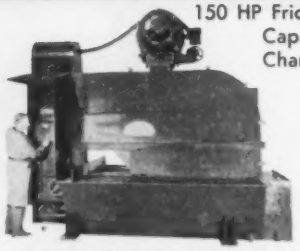
Optotron measuring microscope

Ty-Sa-Man America's Most Complete Line of Industrial Sawing Machinery

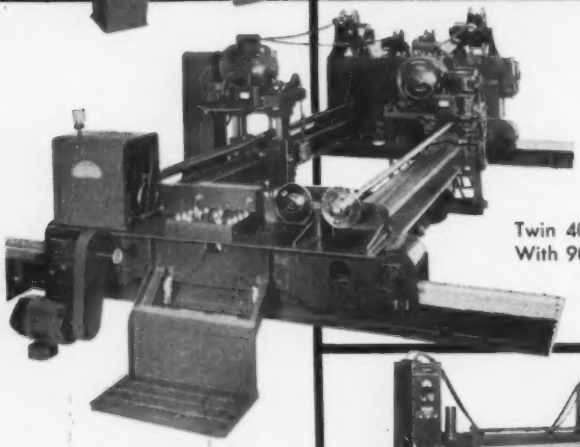
30 HP Chop Saw, Capacity 8" Rounds or Beams



150 HP Friction Saw Capacity 24" Channel

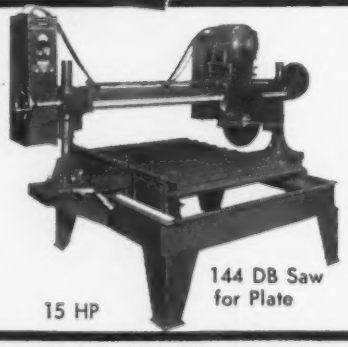


75 & 40 HP Model Available



Twin 40 HP Gantry With 90° Swivel Heads

If you can't cut it with a standard saw . . . call us! Ty-Sa-Man has built thousands of special and standard saws, one of which may solve your problem. If not, our engineering staff is at your disposal.



144 DB Saw for Plate

15 HP

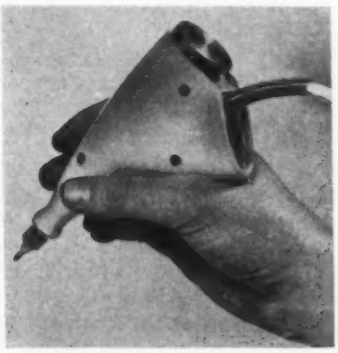
TY-SA-MAN
MACHINE COMPANY, Inc.
1093 White Avenue
Knoxville 1, Tennessee

Write Today for Free Brochure
A brochure pictures and describes the functions of many metal saws. If you have a cutting problem, write or call today.

low-priced instrument is being assembled and distributed by Opto-Metric Tools, Inc., New York City. This instrument is equipped with interchangeable Leitz optics throughout, including a triple nosepiece for 30×, 100×, and 400× magnification, but these may be varied to suit individual requirements. Low-voltage substage and vertical illuminators are standard equipment.

The measuring stage runs or rolls on balls and has a range of 1 by 1 inch, with direct-reading micrometers showing measurements to 0.0001 inch. Coarse and fine focusing is, of course, available. Also, there is a dial gage for depth measurements in 0.0001 inch. The lower-power magnifications serve for measurements in transmitted or reflected light, while the high-power magnifications permit the examination of metallographic specimens.

Circle 619 on Readers' Service Card



Burgess Vibro-Graver

Vibro-Graver for Use on Metal and Nonmetal Parts

Burgess Vibrocrafters, Inc., Commercial Products Division, Grayslake, Ill., has brought out a deluxe electric Vibro-Graver with a carbide point which operates at a speed of 7200 vibrations a minute. This tool will write names, initials, or code numbers on tools, machinery, or parts for permanent identification. Portable and as easy to use as a pencil, the Vibro-Graver is encased in unbreakable polypropylene with a comfortable hand-rest design. Adjustments are easily made by a control wheel for fine, medium, or coarse stroke.

Circle 620 on Readers' Service Card

Rotary Indexing Table for Small Precision Work

A Milichex rotary indexing table 7 inches in diameter has been added to the recently announced line of precision indexing tables offered by the Michigan Tool Co., Detroit, Mich. Whole-degree angular indexing to an accuracy within 1/4 second of arc (equivalent to 12 millionths of an inch at a diameter of 20 inches) is possible with this equipment. Designed for smaller work, this

Milichex right-angle base rotary indexing table for small work

PRODUCTION-MINDED and PRECISE

When the name plate states "It's a HAMILTON TOOL," you can "Use it with confidence."

The NEW Hamilton-Varimatic,® a radial type drilling machine with super sensitive feed, produces small holes (to 5/16" dia.) with instrument precision — at production speeds.

Spindle speeds are infinitely variable. A simple adjustment of the graduated hand wheel selects any desired spindle speed between 840 and 2700 R.P.M., or between 2900 and 9300 R.P.M.

It is available with conventional base and work table, or with "tool-room base" and compound table as shown at the left. Also offered in multiple spindle designs.

2959

HAMILTON TOOL

GET THIS

Bulletin No. 2959 provides complete description, includes sectional drawing, lists features, gives specifications. It's FREE. Write for it now!

THE HAMILTON TOOL COMPANY

834 SOUTH NINTH STREET HAMILTON, OHIO

Model MX-3600 7-inch Milichex is identical in operation to the larger models. Table top and base each have 360 ground and lapped teeth that mesh for positive positioning and locking. In operation, a lever is shifted to raise the table. The top is then rotated to the desired angular position indicated by a scale. The lever is then returned to its original position, lowering and locking the table. Automatic locking of the table in the exact position is accomplished by the meshing of the 360 precision-ground teeth. Wear is no problem, since accuracy will actually increase with wear as the teeth lap each other to a closer fit.

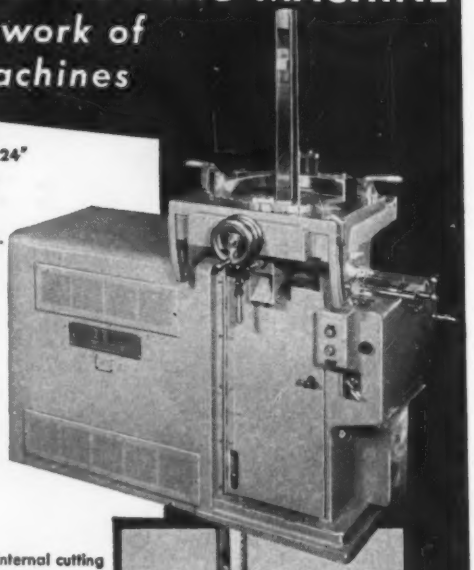
An optional version Model MX-3600R with right-angle base permits using the Milichex either horizontally or vertically. As a rotary indexing table it can be used for machining or inspecting. Sealed design permits use with coolants or lubricants. The top is flat and parallel within 0.000050 inch.

Circle 621 on Readers' Service Card

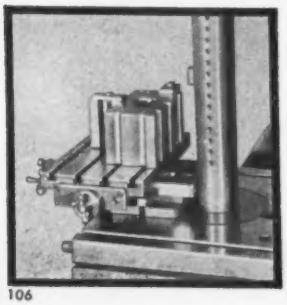
AMAZING NEW HYDRAULIC M&M KEYSEATER AND VERTICAL CUTTING MACHINE

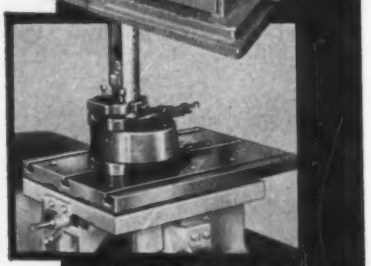
does the work of many machines

In addition to a keyseater that cuts internal keyways up to 3" wide x 24" long, the new hydraulic M & M is a handy tool room machine and can be easily adapted to special production jobs other than keyways. A wide variety of internal or external cuts, serrations, grooves and teeth can be rapidly made on this machine. With a combination tilting table and index table (shown on machine at right) straight or tapered bores and accurately spaced multiple keyways or splines may be cut at any degree of the circle. Send us prints of your cutting problems.



Right: Set-up for internal cutting
Below: Set-up for external cutting





BUILDERS OF MACHINERY SINCE 1854

106

M&M KEYSEATERS AND VERTICAL CUTTING MACHINES

MITTS & MERRILL • 64 Holden St. • SAGINAW, MICHIGAN

Pope Electrolytic-Grinding Spindles

The Pope Machinery Corporation, Haverhill, Mass., has brought out two new "Anocut" electrolytic-grinding spindles. The Pope Anocut spindle, Fig. 1, is designed for

Fig. 1. Anocut electrolytic-grinding spindle designed for operation at 3000 amperes

Fig. 2. Anocut spindle for operation at 50 amperes made by Pope Machinery Corporation

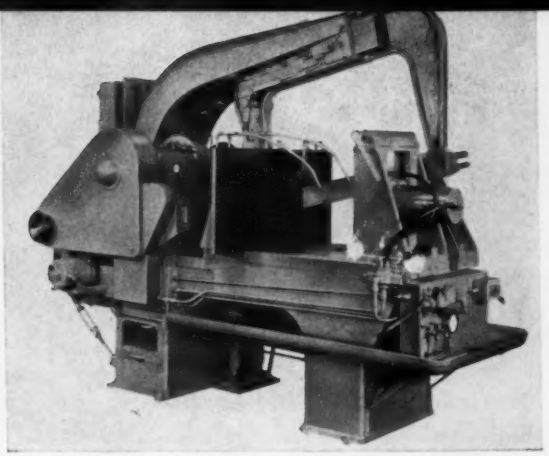
operation at 3000 amperes, while the one illustrated in Fig. 2 is for operation at 50 amperes. These are two of a large number of variety of Pope precision motorized and belt-driven spindles arranged for electrolytic grinding at all amperages within this range. Insulation is built in, and the spindles are equipped with a new, rugged fork type brush assembly developed for cool operation.

Circle 622 on Readers' Service Card

Logan Lathes with Variable-Speed Drive

A new series of 14-inch swing lathes, featuring a variable-speed drive of 40 to 1400 rpm and providing instant speed adjustment without shifting the belt, has been introduced by the Logan Engineering Co., Chicago, Ill. These lathes have a 14 5/8-inch swing over beds, 9-inch swing over saddle cross-slides, center distances of 28 inches, and two precision ground V-ways and flat ways. The hardened, ground steel spindle has

Logan Engineering Co.'s variable-speed drive lathe



Metal saw built by Racine Hydraulics & Machinery, Inc.

a 1 3/8-inch hole and a draw-in collet capacity of 1 1/16 inches. The lathe spindle turns on four sealed and shielded precision ball bearings.

A warp-free lathe bed with high, strong walls is braced by oversize ribs to withstand the heaviest stresses. The models are available with 2 1/4-8 threaded nose and L-00 spindles, and with either standard or hardened beds.

Circle 623 on Readers' Service Card

Racine Heavy-Duty Metal Saw

A new heavy-duty hydraulic saw, designated Model 2424, is now the largest in the line of metal saws manufactured by Racine Hydraulics & Machinery, Inc., Racine, Wis. This saw will cut material up to 24 by 24 inches in size, or 25 inches in diameter, employing a 36- by 4 1/2- by 0.125-inch saw blade. A 10-hp, four-speed Lima motor and a built-in three-speed gear-box provide eleven variables in speed ranging from 12 to 145 strokes per minute. The stroke length is 6 inches.

An important feature of the machine is the adjustable-pressure type hydraulic feed, which has a range of 0 to 350 psi. A total downward pressure of approximately 4200 psi can be applied with the double main cylinders. A heavy-duty hydraulic chuck cylinder, adjustable vertically, holds the work-piece. High-density alloys or so-called exotic metals—such as titanium, beryllium, or zirconium—can be readily cut.

Circle 624 on Readers' Service Card

(*This section continued on page 219*)

THE SOLUTION TO YOUR

"JOINT TROUBLE"

IS U. S. DRILL HEADS!

This is no "medicine man" talk! U. S. Universal Joint Heads have greater reserve stamina than you'll ever need! Heavy-duty joints are specially heat treated for greater capacity than rated . . . drivers and spindles have more than ample bearing . . . shaved gears insure smooth, quiet, full-power performance.

Get profit-making universal joint adjustability with U. S. Drill Heads. Less downtime, quicker changeover, positive hole positioning. And, for long production runs, Slip Spindle Plates provide the advantages of fixed center heads.

Immediate delivery on most standard sizes.

Write for catalog AD-57.

Only U. S. Drill Head provides a FULL RANGE of standard Universal Joint Adjustable Heads

Style Head	No. of Drivers	Drilling Capacity	Drilling Area (Dia.)
U-1	8	1/8"	6"
U-1L	8	1/4"	8"
U-1½	6	½" or ¼"	6"
U-2	10 or 12	½" ¾"	10" 9¾"
U-3	10 or 12	15/32" to ⅞"	12"
U-4	12	15/32" to 1-1/16"	15"

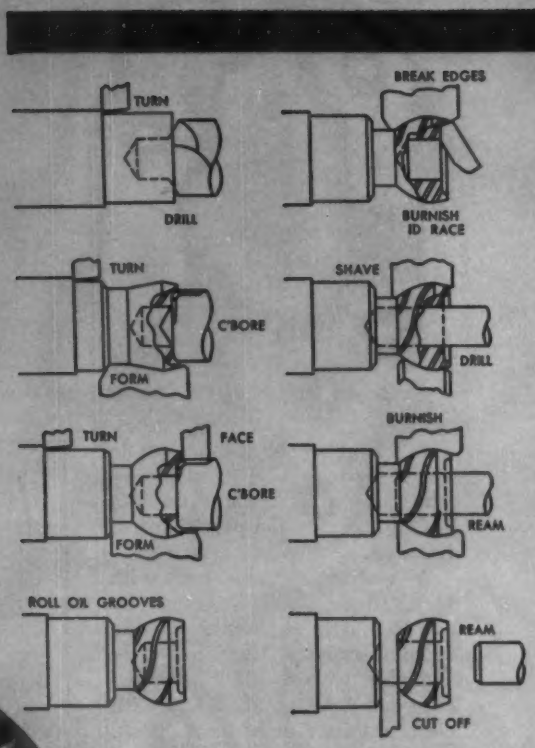
Style U-1 Head with 8 drivers. Price $271. Including 2 spindles with Erickson chucks.

US DRILL HEAD

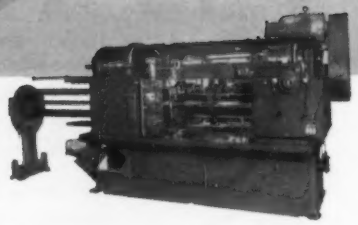
Adjustable and Fixed Center Multiple Drilling Heads. Individual Lead Screw Multiple Tapping Heads.

UNITED STATES DRILL HEAD CO.

5298 RIVER ROAD • CINCINNATI 33, OHIO



One handling **of this Ball Joint (8620 steel) by a 2⅝" 8 Sp. Bar Conomatic *includes* the forming of the oil groove and deburring of the groove.**



Those cost-saving EIGHTS!

With more work spindles and tooling positions for including — in one chucking — operations that would otherwise require the expense of second handling, you just can't *beat* THOSE COST-SAVING EIGHTS.

Likewise, as replacements of four spindle machines — on more simple work — with double stock feed and double setup, producing two pieces per cycle, nothing *compares* with THOSE COST-SAVING EIGHTS.

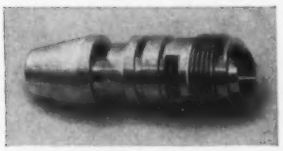
For ever-increasing work requirements — in less floor space, with less power, less coolant, less lubricant and maintenance, and less transfer and paper work — many "automatic" users are finding THOSE COST-SAVING EIGHTS more *profitable*. How about *you*?

Write, wire, or phone *today* for particulars. There is no obligation. Cone Automatic Machine Company, Inc., P.O. Box 27, Windsor, Vermont.

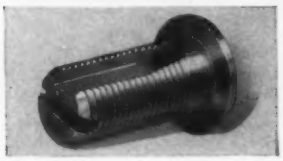
Conomatic

World's Most Productive Line of Automatic Lathes

Consistent, *dependable* handling of one or more of the following operations in a single setup has earned the CONOMATIC an enviable reputation as the *leader* of THOSE COST-SAVING EIGHTS: cross drilling and milling, end milling, broaching, spinning, stamping, OD and ID burnishing, eccentric drilling, turning and boring, eccentric forming, multiple hole drilling and tapping, oil groove rolling, back facing, back slotting, back hole drilling and counterboring, induction hardening and quenching.



One handling of this Sleeve (B-1112 steel) on a 1⅝" 8 Sp. Bar Conomatic *includes* offset milling.



One handling of this Threaded Stud on a 1" 8 Sp. Bar Conomatic *includes* cross milling, slotting, thread chasing, and back facing (all operations without stopping the work spindles).

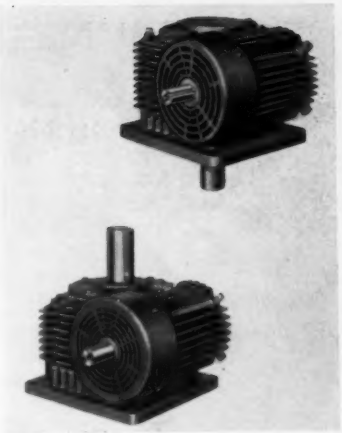
One handling of this Valve Bushing (8620 steel) by a 1" 8 Sp. Bar Conomatic *includes* cross drilling of 4 holes and back counterboring of large hole.

One handling of these bearing cups by a 3" 8 Spindle Bar Conomatic *includes* burnishing, induction hardening and quenching of the ball race.

One handling of this Ball Joint Housing (1012 steel) by a 2⅝" 8 Sp. Bar Conomatic *includes* burnishing inner ball race.

Fan-Cooled Worm-Gear Speed Reducer

The Cleveland Worm & Gear Division, Eaton Mfg. Co., Cleveland, Ohio, has announced the addition of vertical units to its new line of fan-cooled worm-gear speed reducers. Nine sizes, ranging from 3- to 12-inch center distances, are available. Ratios extend from 4 1/7-to-1 up to 95-to-1 and power ratings from fractional to 175 hp. The new units incorporate the same features—such as fan cooling, specially hardened worms and centrifugally cast gears—that were originally designed for the company's first reducers of the fan-cooled line. They have, of course, a much higher rating.



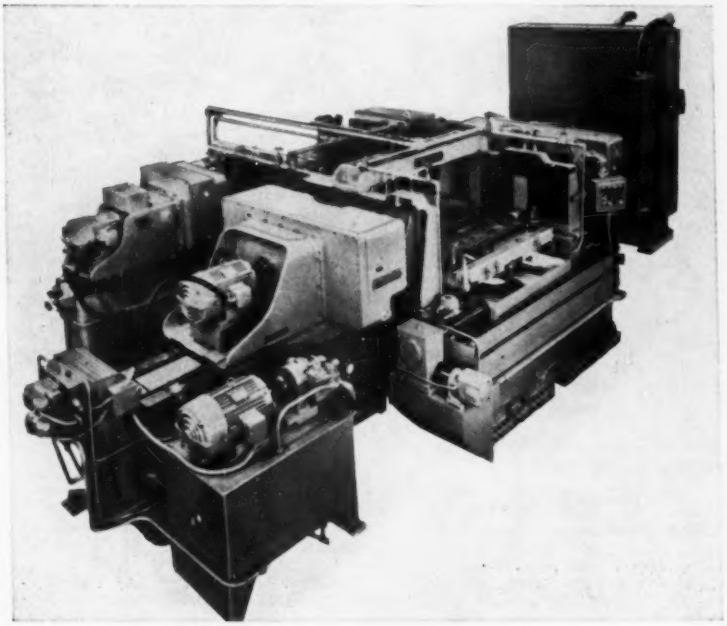
Cleveland vertical drive-shaft worm-geared speed reducers

All of the vertical units have one-piece finned housings designed for maximum strength and heat dissipation. Gear-shaft bearings are grease-lubricated, with two fittings for each bearing. One fitting is used as an indicator; grease flowing from it shows that the bearing is fully packed. Oil seepage, often a problem in reducers with downward shaft extensions, has been prevented by incorporating a dry well around the output shaft which extends above the oil level.

Circle 625 on Readers' Service Card

Five-Way Drilling and Tapping Machine Handles Either Aluminum or Cast-Iron Cylinder Blocks

A compact five-way, three-station transfer machine with 192 spindles—built by the Foote-Burt Co., Cleveland, Ohio—drills, counterbores, and taps all holes in the ends of V-12 aluminum engine crankcases. The machine features an alternate set of pick-off gears on the main drive of each spindle-carrier. These pick-off gears per-



Foote-Burt five-way drilling and tapping machine for V-12 engine crankcases

mit easy speed change for machining either aluminum or cast-iron crankcases.

Hydraulically driven throughout, the machine employs four standard Footburt way units, two on each side of the fixture-carriage bed. These four units, with a total of 181 spindles, ride on square, hardened-steel machine ways. A fifth way unit, mounted at the end of the fixture-carriage bed, employs the manufacturer's exclusive round ways. A single control panel activates all units and the fixture carriage, either independently or in sequence.

At Station 1 the first units advance from left and right to drill sixty-six holes in the block. These tools are mounted on one side of the double-width spindle-carriers. Upon retraction of the units, the chain-driven transfer fixture automatically indexes to Station 2; and the same units advance again to counterbore, chamfer, and drill fifty-nine holes, using tools mounted on the other side of the spindle-carrier. After indexing to Station 3, the remaining three units advance to tap sixty-seven holes, completing the job. The fixture carrier then retracts to the loading position at Station 1.

Compact transfer machines of this type can be custom-fabricated with any number of stations, spindle-carriers, or spindles.

Circle 626 on Readers' Service Card

For { 8-STATION PRODUCTION MACHINING
1½" BAR AND COLLET WORK
CHUCKING
SINGLE POINT THREADING

Costs { $7,167.00 FOB Factory Complete with all standard equipment

This is an all new 1½" bar capacity ram type turret lathe with power feeds to all 8 working stations . . . that in addition to bar and collet work also has the versatility to do chucking, and when needed, single point threading. Powered by a 5 h.p., two-speed, geared motor, the new Sheldon 3 R turret lathe provides 16 spindle speeds, 60 different feeds to the carriage and cross-slide, and 180 different feeds to the ram turret.
The turret itself is ruggedly built and accurately machined to provide close tolerance indexing. And for complete ease of operation, it is put under power by simply pressing a push button on the control panel.

This new 3 R Sheldon is completely equipped with two-speed motor and electrical controls, coolant system and splash guards, LO spindle nose, large satin chrome dials and hardened bed ways. It also provides an additional cost saving feature—each turret face is drilled and tapped for your standard flange type tooling as well as being bored for your standard 1½" shank type tooling.
For versatile, accurate machining in either long or short runs, the new Sheldon 3 R provides the answer to low investment cost with high profit operation.

New SHELDON
3R-TURRET LATHE

Write for bulletin with complete specifications and tooling data

SHELDON MACHINE CO., INC.
4246 N. Knox Ave. • Chicago 41, ILL.
Builders of 10", 11", 13", 15" Sheldon lathes, Sheldon Milling Machines, Sheldon Shapers and Sebastian Geared Head Lathes

See us at Booth #1250 ASTME Show, New York Coliseum.

"Auto-tap" Lead-Screw Tapping Head

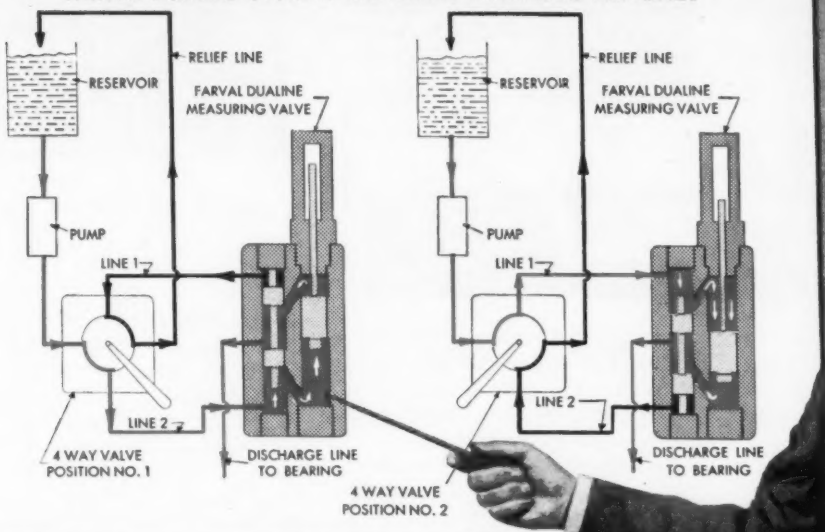
Lead-screw tapping head that fits any drill press (but uses it for power only) introduced by Ettco Tool & Machine Co., Inc., Brooklyn, N. Y. This new unit, identified as the Model No. 2LS "Auto-tap," has actuating lever and stop and depth control as integral parts of its design. The lead-screw carries the thrust, while the tap only cuts the thread, according to the maker's announcement. It is claimed that with this new tapping unit, even unskilled operators can produce precision tapped holes. Production rates are said to be increased, while tap breakage and work spoilage are reduced, as a result of the Auto-tap design and operating advantages. The unit will drive taps up to 5/16 inch or as fine as No. 0. The hardened and precision-ground lead-screw runs in a special-alloy bronze nut, adjustable for wear, and is powered by a sensitive cone clutch that runs in oil. A positive depth control assures accurate threads even in blind or recessed holes. All tapped parts have thread starting at the same point.

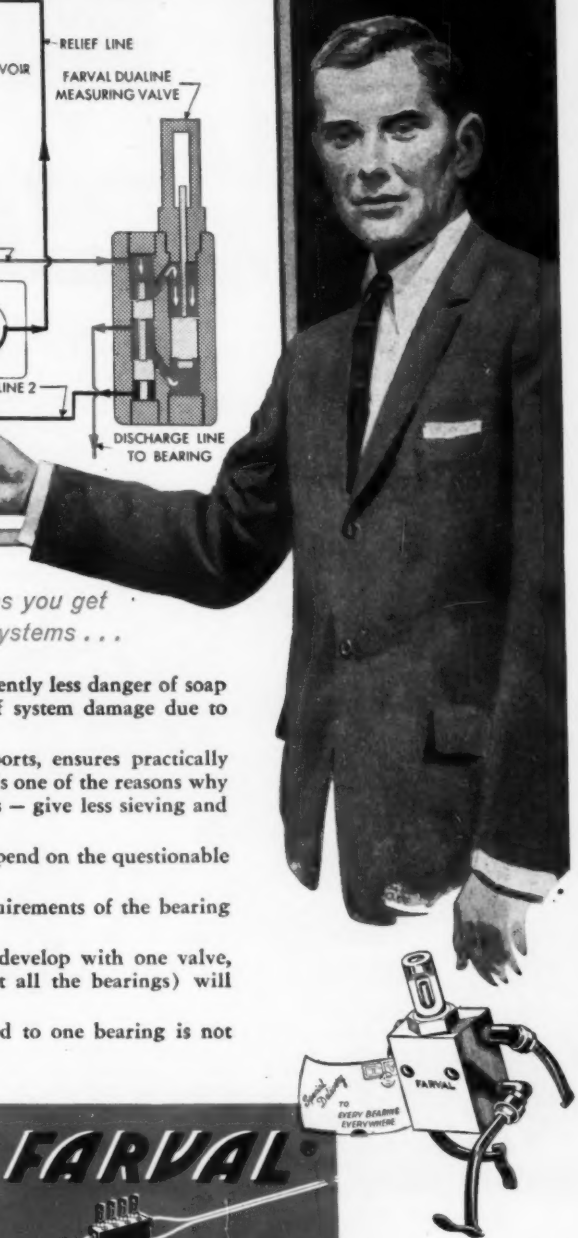
Circle 627 on Readers' Service Card

FARVAL
—Studies in Centralized Lubrication
No. 246

"For positive lubrication of large, medium and heavy-duty installations . . . it's a Farval Dualine System!"

FARVAL DUALINE SYSTEMS USE SIMPLE HYDRAULIC PRINCIPLES





With Farval Dualine centralized lubricating systems you get the following distinct advantages over other type systems . . .

(a) Much lower operating pressures with consequently less danger of soap separation on grease systems. Also, less danger of system damage due to high lubricant pressures.

(b) Large lubricant passages with no pinhole ports, ensures practically full pump pressure for every metering valve. This is one of the reasons why Farval Dualine systems operate on lower pressures — give less sieving and working of lubricants.

(c) Positive indication at each bearing — does not have to depend on the questionable action of a single indicator at the pump.

(d) Each metering valve individually adjustable for the requirements of the bearing it serves.

(e) Independent metering valve operation. Should trouble develop with one valve, the system will continue to operate. Only one bearing (not all the bearings) will require hand lubrication until trouble is corrected.

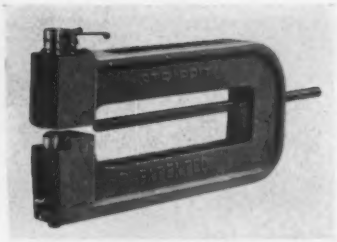
(f) True lubricant metering. Quantity of lubricant delivered to one bearing is not dependent on any other valve in the system.

(g) Much easier to spot and correct trouble.

Check with your Farval Representative and see how these versatile systems can improve production operations — reduce costs. Or write for free Bulletin 26-T containing complete engineering information on Farval Dualine systems.

Farval Division
Eaton Manufacturing Company
3276 East 80th Street • Cleveland 4, Ohio

For more data circle this page number on card at back of book



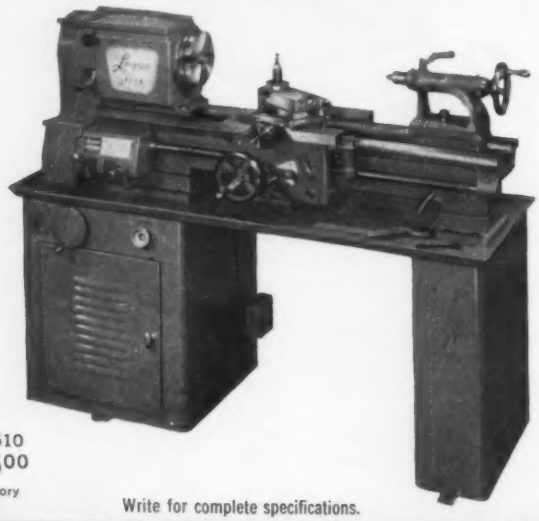
Hole-Punching Unit

"BN" hole-punching unit designed for use with or without guide buttons brought out by Wales Strippit Inc., Akron, N. Y. With this unit only a punch and die are required to punch both round and shaped holes. For special applications and for optimum hole quality, the option of using a fitted or closed guide is still available. The new units have a number of other features that make them especially adapted for use in punching holes in material up to 10 gage. All holders are keyed and are supplied with self-storing keys so that both round and shaped punches and dies can be used in the same holder. The new design of the die section permits easy removal and rotation of the die without removing the holder from the setup. Hold-down slots facilitate mounting; new threaded gage rods provide more accurate and positive positioning of work; and new retainer clips permit faster removal of stripping guides.

Circle 628 on Readers' Service Card

NEW! Logan | 14" LATHES BEST DOLLAR VALUE IN THE LATHE FIELD

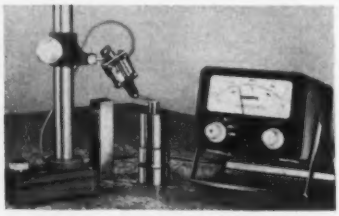
These new Logan 14" swing lathes are DEPENDABLE. Their capacity permits a broad range of machining operations. They have a 14⅛" swing over bed, a swing over saddle cross slide of 9", and a center distance of 28". Logan lathes are ACCURATE. The ball bearing spindle has a 1⅛" hole and a draw in collet capacity of 1 1/16". The variable speed drive (40 to 1400 RPM) adjusts while running —no need to stop and shift belts! Also, the two V-ways and flat ways are precision ground. Logan 14" lathes are RUGGED. The 10" wide and 56" long lathe beds are braced by oversize ribs to withstand torsional stresses. The Logan 14" lathe is your best dollar value. No other lathe in this price category offers you this same big work capacity with variable speed drive.



Model 6510
$1,775.00
F.O.B. Factory

Write for complete specifications.

Logan
LOGAN ENGINEERING CO., DEPT. K-461
4901 W. Lawrence Ave., Chicago 30, Ill.

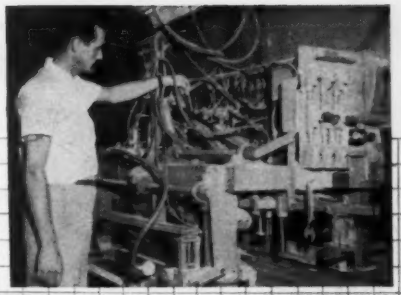


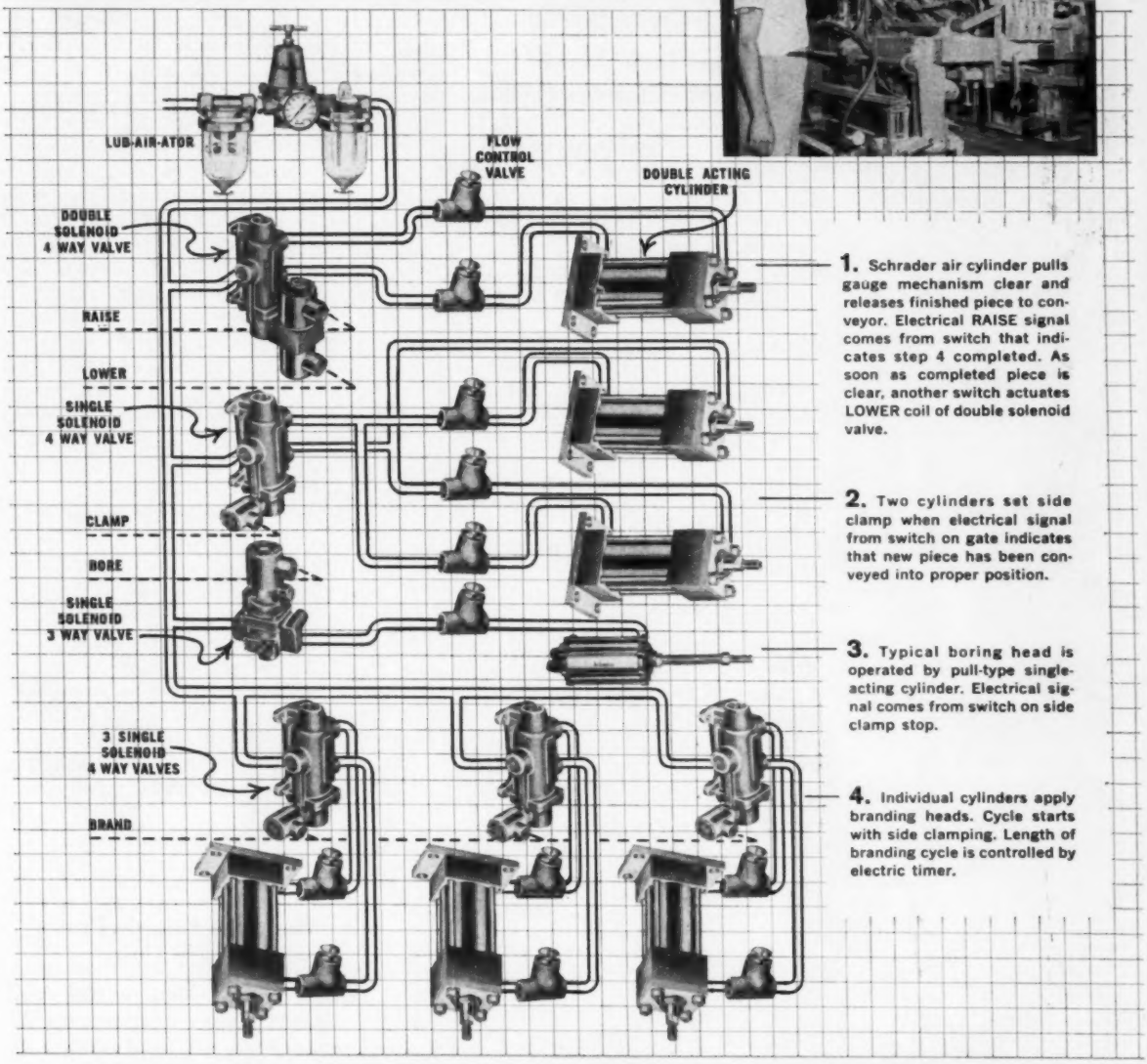
Electronic Gaging Unit

Improved electronic gaging unit, known as the Electro-Probe, announced by Federal Products Corporation, Providence, R. I. Basic components are small versatile gage head and lightweight, all transistor amplifier-meter which is battery operated and permits instant operation without need for warm-up time. The gage head, battery, and accessories are contained within the housing of the amplifier, which serves as the carrying case of the gage. The carrying handles also serve as adjustable legs for setting the meter at any angle desired for easy viewing. Any two of six different gaging ranges, from 0.002 to 0.010 inch, can be combined in the amplifier-meter, providing magnifications up to 11,000. Scales are correlated and provide minimum graduations from 0.000010 to 0.0005 inch, depending on the two scales selected. A new contact tip automatically compensates for setting contact arm at any angle up to 20 degrees with work, thus eliminating the need to apply correction factors as normally required. A new two-speed control for setting zero electrically combines rapid long-range approach and closely controlled fine adjustment. The gage head operates virtually without friction, applying only 2.5 grams of pressure to the work, thus permitting accurate, high-magnification measurements using regular type height gage and test-set fixtures.

Circle 629 on Readers' Service Card

The Lane Furniture Company of Altavista, Virginia, broke its cedar chest production line into groups of operations for air-automation. One of the many circuits, shown here, was designed with quality Schrader components to brand the chest tops with a trademark, bore hinge recesses, and perform vertical and horizontal gang drilling operations. All three jobs are completed in less than 30 seconds!





1. Schrader air cylinder pulls gauge mechanism clear and releases finished piece to conveyor. Electrical RAISE signal comes from switch that indicates step 4 completed. As soon as completed piece is clear, another switch actuates LOWER coil of double solenoid valve.

2. Two cylinders set side clamp when electrical signal from switch on gate indicates that new piece has been conveyed into proper position.

3. Typical boring head is operated by pull-type single-acting cylinder. Electrical signal comes from switch on side clamp stop.

4. Individual cylinders apply branding heads. Cycle starts with side clamping. Length of branding cycle is controlled by electric timer.

MANUFACTURER AUTOMATES PRODUCTION LINE WITH SCHRADER AIR CIRCUITRY... COMPLETES 3 JOBS IN 30 SECONDS

If your plant has production lines too long, unwieldy and costly to compete effectively, take a tip: Break your entire manufacturing sequence into logical *groups* of jobs. Then develop air-powered and air-controlled machines to perform each group in sequence. This company did, and now has versatile, fast, and economical production. *You already have air.* Expand its uses with versatile Schrader Air Products and discover true efficiency.

There is a fully stocked Schrader Distributor nearby . . . staffed with experts to help you solve any air circuitry problem. Consult the Yellow Pages or write:

Schrader®
a division of SCOVILL

A. SCHRADER'S SON
Division of Scovill Manufacturing Company, Incorporated
454 Vanderbilt Avenue, Brooklyn 38, N. Y.

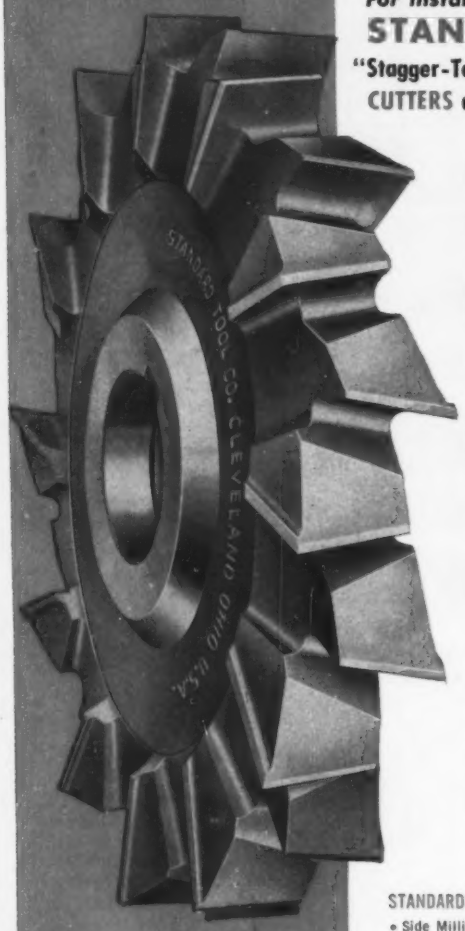
QUALITY AIR CONTROL PRODUCTS

For more data circle this page number on card at back of book

MORE metal removed at LESS COST . . Standardize with STANDARD'S Quality!

For instance . . .
STANDARD'S
"Stagger-Tooth" ROTARY
CUTTERS are designed with . . .

alternate right and left spiral teeth for improved deep-slot milling!



• BALANCED CUTTING ACTION of staggered teeth allows heavier cuts for smoother machining of tough materials.

• Tooth design provides extra space for BETTER CHIP CONTROL!

• STANDARD'S Quality assures LONGER TOOL LIFE, KEENER CUTTING EDGE!

STANDARD Cutters meet job requirements:

- Side Milling Cutters
- Plain Milling Cutters Heavy Duty . . . Regular
- Form Relieved Cutters
- Helical Plain Cutters
- Key Seat Cutters
- Slitting Saws
- Screw Slotting Cutters

DEPEND upon STANDARD'S Authorized Distributors . . .
For Twist Drills, Reamers, Taps, Counterbores, End Mills, Milling Cutters, Hobs, Gages, Dies, Carbides (solid or tipped) . . . and for Engineering or Technical Information.

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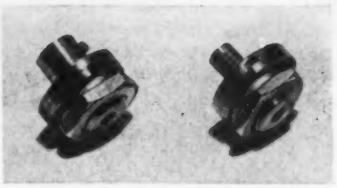
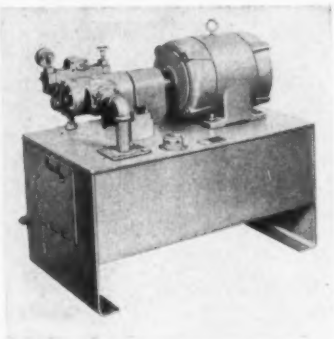
BRANCH WAREHOUSES IN: NEW YORK · DETROIT · CHICAGO · DALLAS · LOS ANGELES · SAN FRANCISCO



Miniature Cam Assemblies

Adjustable cam assemblies, in a newly developed miniature size, now available from Pic Design Corporation, East Rockaway, N. Y. Designed for use in all precision timing applications, the new assemblies feature positive locking at any predetermined operational setting, within a range of 0 to 180 degrees. Machined from No. 303 stainless steel, with clear passivated finish, they are stocked in 0.1248-, 0.1873-, and 0.2498-inch bore sizes, in pin or clamp type hub styles.

Circle 630 on Readers' Service Card



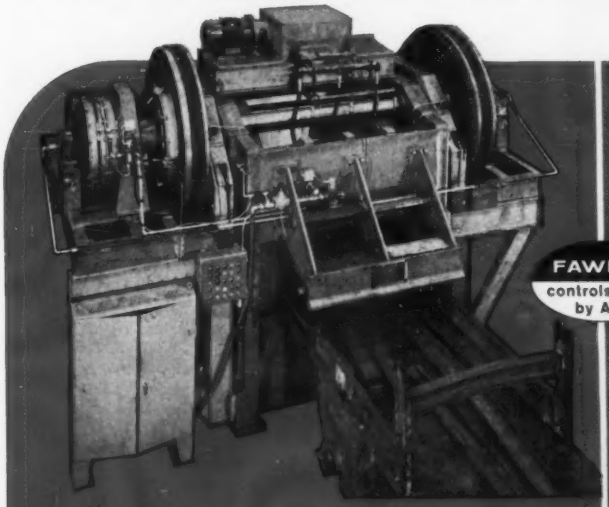
Hannifin Double-Pump Power Units

One of a new line of 1000- and 2000-psi double-pump power units for general industrial service announced by the Hannifin Co., Des Plaines, Ill., a division of Parker-Hannifin Corporation. This power unit is offered in standard 30- and 60-gallon reservoir sizes, with combined pump capacities up to 33 gallons per minute. All units incorporate a motor which operates at a speed of 1800 rpm. By utilizing double pumps in conjunction with the "Hi-Lo" unloading valve panel, horsepower requirements are reduced, oil temperatures are lowered, and maximum circuit efficiency is realized. They can be had with two individual relief valves if desired.

Circle 631 on Readers' Service Card

DESIGN or MODERNIZE HEAVY CYCLIC MACHINES

...with Fawick VC Ventorque Clutches



FAWICK controls best by AIR

NEW rotary scrap shear incorporates advanced dual drive system using a Fawick VC Ventorque Clutch in each of two flywheels for synchronized power transmission. Clutches engage opposite ends of main drive shaft instantly, and simultaneously, to avoid shaft twist and provide even knife pressure during operation of the 585-ton-capacity machine. Automatic self-adjustment for wear assures equal torque transmission at opposite ends of shaft, cycle after cycle. Dual element VC Ventorque Brake at shaft end (left) provides braking torque. Shear was designed and built by The Hill Acme Company, Cleveland.

MODERNIZATION of this 600-ton press at major automotive plant has increased production and reduced maintenance downtime. Press Conversion Package includes crankshaft-mounted Ventorque Clutch and spring-applied CS Brake. Since installation three years ago, downtime due to replacement of clutch or brake parts has been completely eliminated.

... for *maximum production under severe conditions*

FAWICK VC Ventorque Clutches and Brakes provide the kind of rugged-duty power transmission that boosts production and precision on even the heaviest machines.

Machine operating speed or efficiency can be increased because Ventorque Clutches respond instantly and accurately. Drum-type air clutch design incorporates ventilated construction for continuous cooling. This keeps torque capacity high and clutch performance at its peak under the toughest operating conditions. Simplified design and cool operation insure long friction life and extremely low clutch maintenance costs.

Ventorques are available in 14 standard sizes with torque capacities from 27,000 to 1,800,000 in.-lbs. at 75 psi. Whether used as original equipment or for modernization, these units are easily installed on all types of heavy cyclic machines.

For complete engineering information and consultation on your application, contact your nearest FAWICK representative or the Home Office.

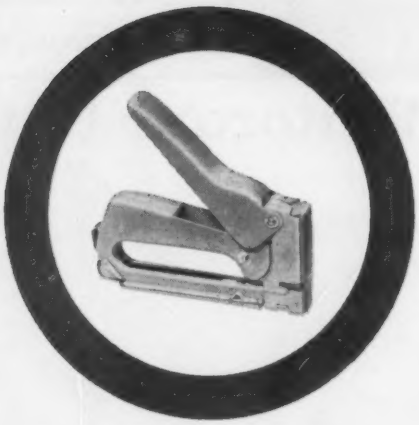
you can design or modernize these machines with VC Ventorque Clutches:

- power presses
- shears
- draw benches
- cut-off machines
- benders
- rolling mills
- upsetters
- seamers
- crankshaft lathes

FAWICK AIRFLEX DIVISION
FAWICK CORPORATION
9919 CLINTON ROAD • CLEVELAND 11, OHIO
Fawick Canada, Ltd., 60 Front St., West, Toronto, Ont., Canada

FAWICK AIRFLEX
INDUSTRIAL CLUTCHES AND BRAKES

For more data circle this page number on card at back of book



FASTER!

Truarc Rings cut assembly time 60%

This production advantage was achieved by Swingline, Inc., with two Truarc retaining rings: a Series 5139 Prong-lock ring and Series 5144 Reinforced E-Ring. They also saved $25 per thousand units and improved the product design by providing resilient end-play take-up . . . eliminating looseness or binding in the parts. Truarc dispensers—loaded with pre-stacked ROL-PAK® cartridges—make ring application simple, fast and economical.

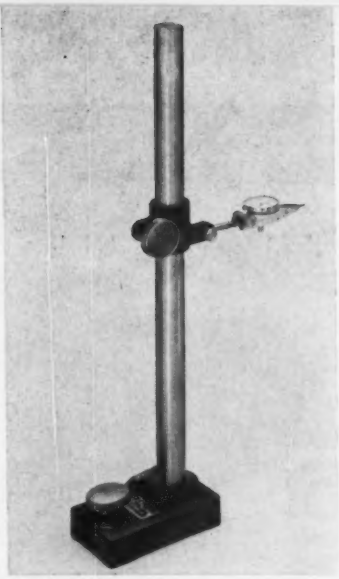
Truarc Rings come in 50 functionally different types . . . as many as 97 different sizes within a type . . . 6 metal specifications and 13 finishes. Write for Catalog 10-58 which shows many specific examples of ring applications. For immediate action, call your nearest Factory Representative or Authorized Truarc Distributor. He's in your Classified Telephone Directory under: "Rings, Retaining."

1.2

WALDES TRUARC® RETAINING RINGS

WALDES KOHINOOR, INC., 47-16 Austel Place, Long Island City 1, N.Y.

9 OUT OF 10 PRODUCTS CAN BE IMPROVED WITH TRUARC RETAINING RINGS



Van Keuren Hyt Stand

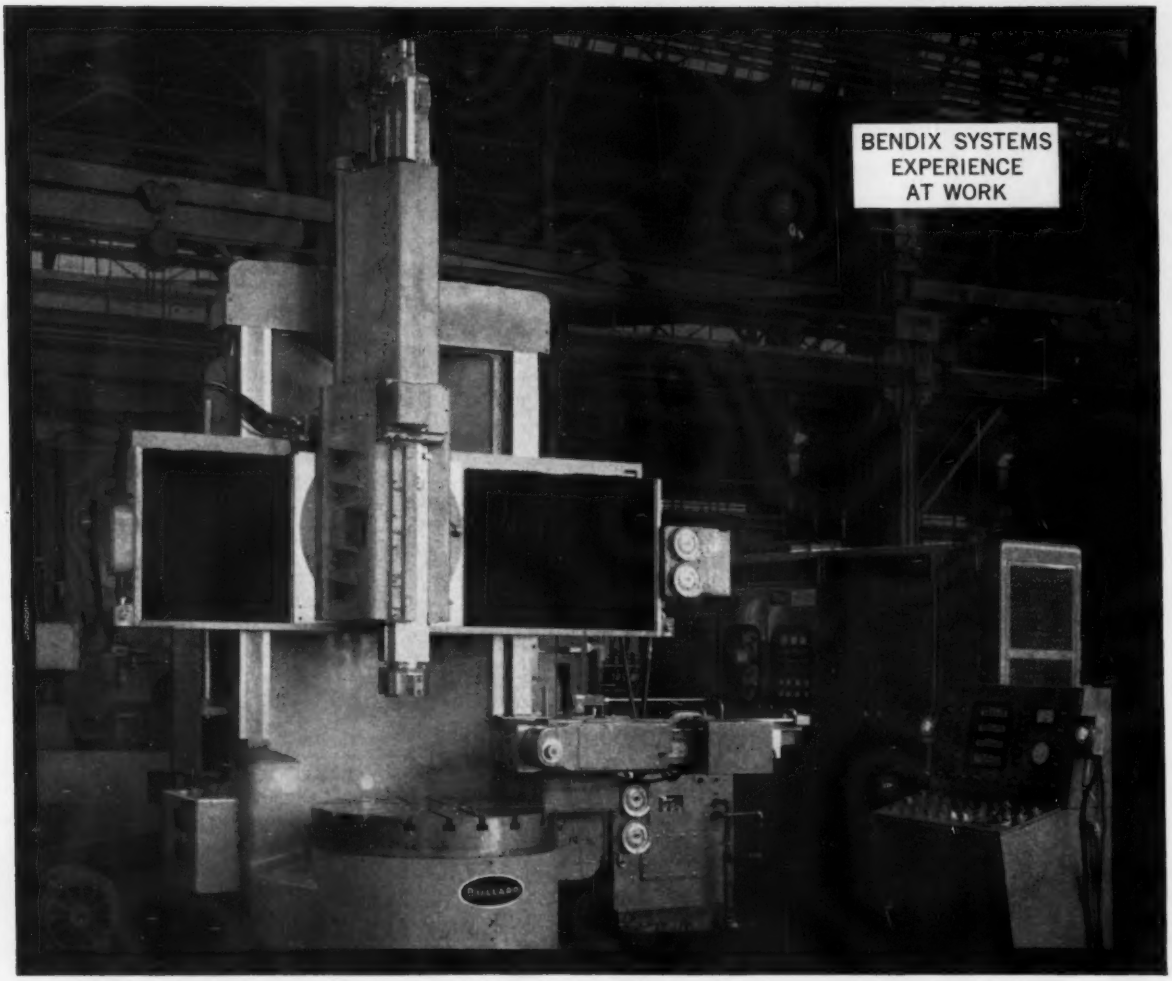
Hyt 24-inch transfer stand available from the Van Keuren Co., Watertown, Mass., for accurate, reliable transfers of height settings. Supplementing the manufacturer's previously introduced 18-inch model, these stands are designed and balanced to assure smooth movement.

Circle 632 on Readers' Service Card

Starrett "Dial-Master"

Superprecision dial indicator with accuracy of plus or minus 0.00001 inch announced by the L. S. Starrett Co., Athol, Mass. This No. 25-106 "Dial-Master" dial indicator is designed for applications requiring extreme precision, such as shop inspection to laboratory standards or for laboratory work. Widely spaced graduations are read in 0.00005 inch, and the dial reading is plus 0.0015 to 0 to minus 0.0015 inch, with a total range of 0.003 inch.

Circle 633 on Readers' Service Card



BENDIX SYSTEM ENGINEERING PROVIDES OPTIMUM NUMERICAL CONTROL FOR TURRET LATHE

Shown above is a Bullard four-axis vertical turret lathe equipped with Bendix DynaPath-14 contouring control unit. In this application, the selection of tools and spindle speeds is programmed, as is the motion of both slides.

Bendix application engineers, with accumulated experience in mechanical and hydraulic analysis of machine tools, worked closely with Bullard to produce this wedding of machine tool and numerical controls. And Bendix systems experience gained in working on other contour turning applications (with such companies as Ex-Cell-O, Heald, and Giddings & Lewis) assures the user correct application of control unit to machine tool.

In addition to contour turning applications, Bendix engineers numerical control systems for milling, grinding, drilling and jig boring machines. We have developed and applied controls to 2-, 3-, 4-, and 5-axis systems, both continuous path and point-to-point. These controls are being used daily in plants across the country to increase machine tool efficiency, reduce lead times, and make parts of consistently high accuracy.

Bendix SYSTEMS EXPERIENCE can provide the key to your machine tool problems. The right Bendix numerical control unit can be the profit-maker you've been looking for. Start putting Bendix application engineering experience to work for *you*—write today for a copy of our catalog number 308.

BENDIX PROVIDES SYSTEMS EXPERIENCE

JUSTIFICATION STUDIES • SYSTEM ENGINEERING • TRAINING AND SERVICE

Industrial Controls Section

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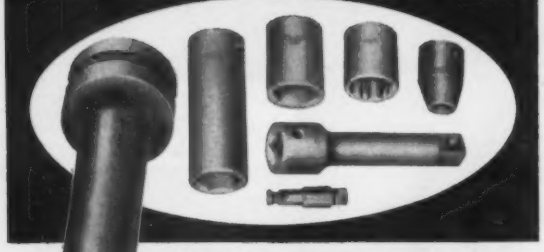
THE Bendix CORPORATION

EXTRA TOUGH TO RESIST CONSTANT SHOCK



WILLIAMS
POWER DRIVE
SOCKETS

Your Williams Distributor is ready for action with Williams Power Drive Sockets. Made of extra tough alloy steel. Specially heat-treated to withstand constant impacting and power nut running. Available in 7 drive sizes: ¼", ⅜", ½", ⅝", ¾", 1" and 1½". Hex, double hex and square openings from 5/16" to 3½". Standard and bolt clearance lengths, magnetic styles, plus adapters, extensions and shanks offer complete range of service.

430 SOCKET ITEMS, 7 DRIVE SIZES FOR ALL TYPES OF POWER WRENCHES

J. H. WILLIAMS & CO.
DIVISION OF UNITED-GREENFIELD CORPORATION
409 VULCAN ST., BUFFALO 7, N.Y.

WILLIAMS

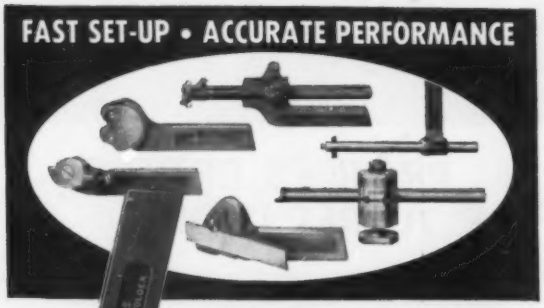
For more data circle Item 228A

"Clipper Twin" Foot-Switch

Heavy-duty, low-cost "Clipper Twin" foot-switch designed for positive control of "up-down," "slow-fast," and other reversible operations, introduced by Linemaster Switch Corporation, Woodstock, Conn. Each of the two rugged foot-switches, mounted on a common steel baseplate, provides a momentary contact (press to start, release to stop) for SPDT circuits rated to 20-ampere, 125-250-volt alternating current and 1-hp, 115-230-volt alternating current. Only one external power cable is needed; a tube between treadles conceals internal wiring. A skid-proof base prevents sliding, while four mounting holes allow rigid attachment to floor or equipment, if desired. Over-all size of the switch is 8 3/8 inches wide, 4 1/2 inches deep, and 1 1/2 inches high at the treadle-operating end.

Circle 634 on Readers' Service Card

FAST SET-UP • ACCURATE PERFORMANCE



WILLIAMS
DROP-FORGED
TOOL HOLDERS

Standardize on Williams Tool Holders . . . available in a complete range of sizes and patterns for turning, boring, threading, knurling, planing, cutting-off and side work. Correctly designed for fast, easy set-up and rigid, chatter-proof cutting. Drop-forged from tough quality steel . . . heat-treated for added strength . . . machined to close tolerances. Your Williams Distributor can also supply a full line of high speed cobalt and carbide cutters.

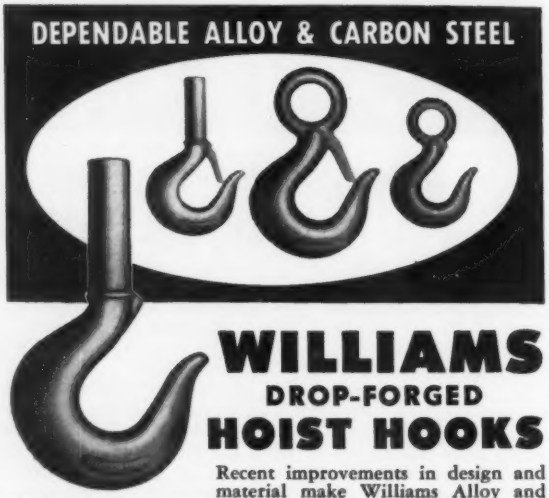
FOR ALL REGULAR LATHE AND PLANER OPERATIONS

J. H. WILLIAMS & CO.
DIVISION OF UNITED-GREENFIELD CORPORATION
409 VULCAN ST., BUFFALO 7, N.Y.

WILLIAMS

For more data circle Item 228B

DEPENDABLE ALLOY & CARBON STEEL



WILLIAMS
DROP-FORGED
HOIST HOOKS

Recent improvements in design and material make Williams Alloy and Carbon Steel Hooks the strongest, safest to specify. Each is heat-treated for maximum toughness and high impact resistance. All are proof-tested to military standards to 50% beyond safe working loads. Available in eye and shank styles in regular and safety patterns. Safety latches feature non-corrosive snap springs with positive, safety action. Alloy steel capacities up to 70 tons . . . carbon steel capacities up to 60 tons. Order from your Williams Distributor.

SIXTEEN STOCK SIZES
CAPACITIES UP TO 70 TONS

J. H. WILLIAMS & CO.
DIVISION OF UNITED-GREENFIELD CORPORATION
409 VULCAN ST., BUFFALO 7, N.Y.

WILLIAMS

For more data circle Item 228C

Barber-Colman Reference Voltage Unit

This Model 350 reference voltage source announced by the Barber-Colman Co., Rockford, Ill., is a component designed for use with null-seeking galvanometer type indicating controllers. This combination gives a measuring system for those critical control applications requiring extreme measuring sensitivity on processes which incorporate minimum time lags compatible to 5 per cent or less proportioning band. A three-digit dial provides minute (1-degree) adjustment of set point. Null-balance circuitry eliminates the effect of lead-wire length on calibration. The unit incorporates a Zener Diode stabilized source. Adding resistances provides a choice of response times. Cold junction compensation is continuous. Over-all measurement sensitivity is 0.25 degrees F. and is better with base-metal thermocouples.

Circle 635 on Readers' Service Card

DEPENDABLE FOR EVERYDAY USE
WILLIAMS
MISCELLANEOUS
HAND TOOLS
Over 550 Williams Hand Tools are available . . . Screwdrivers, Pliers, Hammers, Punches, Chisels, Pullers, Chain Wrenches, Tube Cutters, Flaring Tools . . . to mention only a few. All are made for heavy-duty, long-lasting performance. Whatever the job at hand, you can do it quickly, easily and safely with Williams Hand Tools.
CALL YOUR WILLIAMS DISTRIBUTOR
HE CAN GIVE IMMEDIATE SERVICE
J. H. WILLIAMS & CO.
DIVISION OF UNITED-GREENFIELD CORPORATION
409 VULCAN ST., BUFFALO 7, N.Y.
WILLIAMS

For more data circle Item 229B

BUY FROM STOCK AND SAVE
WILLIAMS
DROP-FORGED
HANDLES
Why use "specials" when Stock Handles from your Williams Industrial Distributor can do the same job and save you money? Eleven Crank Handles from 1¾" to 10" (C. hub to C. handle). Eight Balance Handles from 1¼" to 3⅞" (C. hub to C. handle). Nine Ball Pattern Machine Handles from 2" to 6⅜" long. Four Cone Pattern Machine Handles from 3½" to 6". Crank and balance handles heat-treated.
4 STYLES, 62 STOCK ITEMS
HANDLE MOST REQUIREMENTS
J. H. WILLIAMS & CO.
DIVISION OF UNITED-GREENFIELD CORPORATION
409 VULCAN ST., BUFFALO 7, N.Y.
WILLIAMS

For more data circle Item 229A

A WIDE RANGE OF STOCK SIZES
WILLIAMS
DROP-FORGED
ROD ENDS
Before you consider specials, or make your own, ask your Williams Industrial Distributor to show you the broad line of Williams Rod Ends. They are drop-forged from mild steel which welds easily. Many sizes are centered for fast drilling. Shank diameters from 3/16" to 1¼" . . . lengths from 1¼" to 24". Head diameters from ⅜" to 2 5/16" . . . thicknesses from ¼" to 1½".
SAVE WITH STOCK ROD ENDS
36 SIZES TO CHOOSE FROM
J. H. WILLIAMS & CO.
DIVISION OF UNITED-GREENFIELD CORPORATION
40 VULCAN ST., BUFFALO 7, N.Y.
WILLIAMS

For more data circle Item 229C

NEWS of the Industry

Isabel Shamlian

Colorado and Texas

BARBER-COLMAN CO., Rockford, Ill., has announced the appointment of JARVIS SUPPLY CO., Denver, Colo., as a distributor for hobs, milling cutters, and reamers.

CLECO AIR TOOL CO., a subsidiary of REED ROLLER BIT CO., Houston, Tex., has announced two changes in its domestic and foreign sales organization. T. E. DONOHUE has been assigned to California, where he will serve as sales manager of the firm's West Coast division. He has headed sales operations for Cleco tools throughout Canada for the last two years. HAAKON JOHNSEN has been named to succeed Mr. Donohue in the Canadian general manager's post at CLECO PNEUMATIC TOOL CO. OF CANADA, LTD. He has previously served as special salesman for the organization, whose headquarters are in Toronto (Leaside), Ontario.

Illinois and Iowa

NORTON D. SKINNER has been made manager–technical services for the International Division of CLEARING, division of U. S. INDUSTRIES, INC., Chicago, Ill. Mr. Skinner's new duties will involve working with Clearing's foreign manufacturers, distributors, and customers. He will also act as liaison for Clearing's Chicago engineering department and its overseas operations. In addition, he will assist foreign customers in metalforming problems.

Norton D. Skinner, manager—technical services for International Division of Clearing, division of U. S. Industries, Inc.

OILGEAR CO., Milwaukee, Wis., has announced that its Chicago district, sales, service, and application-engineering office will be located at 53 E. Saint Charles Road, Villa Park, Ill. Parts of Illinois, Indiana, Kentucky, and Michigan will be covered from this office. CLARENCE (BUTCH) H. PANEITZ, will direct the sale of Oilgear components in this territory, and VITIOUS (VIT) P. JURKONIS will act as engineering representative.

DoALL Co., Des Plaines, Ill., has announced the availability of X-Press taps, which introduce a new concept in tapping by forging instead of cutting internal threads in copper, brass, zinc, lead, aluminum, and other ductile materials.

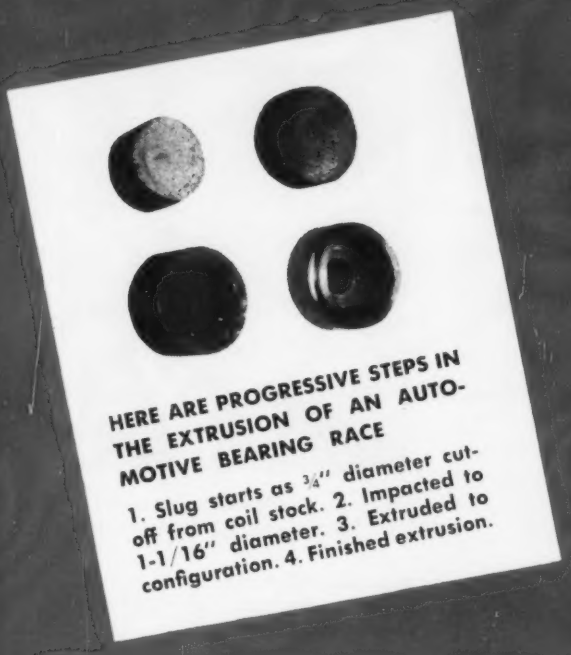
PIONEER-CENTRAL DIVISION of BENDIX CORPORATION, Davenport, Iowa, has appointed A. E. BELL assistant sales manager and KINGSLAND HOBEIN service manager for the division. Previous to his present appointment, Mr. Bell was product manager. Mr. Hobein was formerly supervisor of technical services for the division.

Michigan, Minnesota, and Wisconsin

EX-CELL-O CORPORATION, Detroit, Mich., has announced three personnel changes: RUSSELL D. HUGHES has been named assistant general manager of the Costa Mesa, Calif., plant of CADILLAC GAGE CO; HENRY LAPEZA has been appointed controller of Ex-Cell-O; and FRANK J. ROGERS has been placed in charge of the internal audit department of Ex-Cell-O. Mr. Hughes joined Ex-Cell-O in Detroit in 1951. Mr. Lapeza started with the company in 1956, and has been in charge of the internal audit department until his present appointment. Mr. Rogers came to Ex-Cell-O in 1956, and now assumes charge of the department.

Russell D. Hughes, assistant general manager—Costa Mesa, Calif., plant, Cadillac Gage Co., subsidiary of Ex-Cell-O Corporation

METALLURGICAL PRODUCTS DEPARTMENT, GENERAL ELECTRIC CO., Detroit, Mich., has announced the following: HARRY B. WEAVER has joined the department as specialist–product planning and market development, diamond products. R. S. GRORUD has been transferred from sales representative–midwestern district to sales representative–Pacific district, replacing W. S. BAKER, who has retired. WELDON LUVISI has been appointed sales representative–midwestern district, to replace Mr. Grorud. Separate but interrelated programs of research and development and design and evaluation have been initiated by the department. DR. E. W. GOLIBER, appointed manager–hard-metal research, will conduct basic research on the chemical, metallurgical, and



HERE ARE PROGRESSIVE STEPS IN THE EXTRUSION OF AN AUTOMOTIVE BEARING RACE

1. Slug starts as 3/4" diameter cut-off from coil stock. 2. Impacted to 1-1/16" diameter. 3. Extruded to configuration. 4. Finished extrusion.

"in COLD EXTRUSION SUCCESS DEPENDS ON LUBRICATION"

and *success is yours* when you use

EXTRUDOIL #51 DO CONCENTRATE

MACCO EXTRUDOIL #51 DO CONCENTRATE

- REDUCES PRODUCTION COST . . . INCREASES PRODUCTION DUE TO LESS DOWN TIME BECAUSE OF TOOL CHANGES
- FREER FLOWING OF METAL ASSURES MAINTENANCE OF ABSOLUTE TOLERANCES
- CUTS INVENTORY COST — ONE LUBRICANT DOES *ALL* THE JOBS
- CUTS DIE TRY-OUT TIME

Why is Macco Extrudoil #51 DO Concentrate the first choice of experienced cold extrusion men? The answer is easy . . . Macco research and development, working hand-in-hand with leading extrusion equipment manufacturers, developed this Extrudoil to meet the distinct needs of cold extrusion. Result—today Macco Extrudoil #51 DO Concentrate is far ahead of the field . . . proved in production beyond question . . . used every day in the extrusion of screws, bolts, nuts, bearing races, spark plug shells, worm shafts, gears, tappet bodies, sleeves. If you are now engaged in cold extrusion, or even thinking about it, it will pay you well to talk to a Macco engineer. There's one in your area. If you don't know him, write, wire or phone us. We'll have him see you.

Get the facts . . . find out for yourself why

THE METALWORKING INDUSTRY LOOKS TO MACCO FOR LEADERSHIP

CLEANING COMPOUNDS
CUTTING LUBRICANTS

DRAWING COMPOUNDS
RUST PREVENTIVES
FORGING COMPOUNDS
EXTRUSION LUBRICANTS

MACCO PRODUCTS COMPANY

CHEMICAL COMPOUNDS FOR THE METALWORKING TRADE SINCE 1921

9201 mc S. SANGAMON ST., CHICAGO 20, ILLINOIS
PRESCOTT 9-0800

physical aspects of cemented carbide and related materials. E. J. WELLER, named manager—design and evaluation engineering, will be responsible for the design development and evaluation of all Carboloy products.

ROY R. WINN has been named Great Lakes regional manager for the Industrial Controls Section of BENDIX CORPORATION, Detroit, Mich. Mr. Winn will service the builders and users of numerically controlled machine tools in eastern Michigan, northern Ohio, West Virginia, western Pennsylvania, and western New York states.

ROBERT M. MILLER has been promoted to assistant sales manager of DEVLIEG MACHINE CO.'s machine tool division, Royal Oak, Mich. In his new post, Mr. Miller will be concerned primarily with the sales of the company's Jigmil boring machines and its line of Micropoint cutting-tool grinders.

WILLIAM C. NEWBERG has been engaged as a consultant for the DETROIT BROACH & MACHINE CO., Rochester, Mich. Mr. Newberg was formerly president of CHRYSLER CORPORATION.

William C. Newberg, consultant for Detroit Broach & Machine Co.

O'NEIL-IRWIN MFG. CO., Lake City, Minn., has changed its name to DI-ACRO CORPORATION, since the Di-Acro brand name has been promoted through the years almost to the exclusion of the O'Neil-Irwin corporate name.

GEORGE A. VERHAEGHE has been named vice-president in charge of sale of hydraulic products for RACINE HYDRAULICS & MACHINERY, INC., Racine, Wis. Mr. Verhaeghe has been associated with the firm for the past fourteen years, principally in engineering and sales.

RAY HEIZER has been appointed general manager for GISHOLT PLASTICS, Madison, Wis. Before coming to Gisholt, he served as a research and development engineer and as a chief engineer in the molding of reinforced plastics.

New England

HENRY T. LOWELL, JR., has been appointed general sales manager for the BALDWIN-LIMA-HAMILTON CORPORATION's force measurement products group, according to an announcement by the company's electronic and instrumentation division, Waltham, Mass. Mr. Lowell will be responsible for the sale of SR-4 strain gages, BLH strain-gage transducers, instrumentation, and related systems. He will coordinate the efforts of several product sales managers and work closely with sales engineering representative offices located throughout the United States and in many foreign countries around the world.

125 Ton Heavy Duty O.B.I. Press

STANDARD EQUIPMENT
Air clutch. Air-release, spring-set brake. J.I.C. wiring and controls. Solenoid —controlled dual air valves. Adjustable gibs with bronze or composition faced ways on slide. Hard bronze crankshaft bearings. One-shot forced lubrication. *Optional equipment as required.*

- **Completely new design in geared and non-geared types incorporates *proven* construction features.**
- **Exceptional rigidity insures long die life and close product tolerances..**
- **Large box-type slide mounted in long gibs holds accurate alignment.**
- **125 ton capacity covers wide variety of jobs.**
- **Big die capacity—bolster area 29" x 42"—shut height 18", or to suit.**
- **Versatile — efficient — dependable.**

WRITE for complete information on this new press. Also, 14 to 150 ton O.B.I. presses, 20 to 150 ton straight side presses, 30 to 75 ton gap frame presses.

L & J PRESS CORPORATION 1631 STERLING AVE. ELKHART, IND.

For more data circle this page number on card at back of book

IF COMPETITORS MATCH YOU IN PRICE AND QUALITY...

the *LOCTITE* method can give you a double edge

The LOCTITE Method is a bold new approach in metalworking assembly. It reduces rejects, machining time, assembly failure, customer complaints . . . saves on parts and inventory.

Here's what it does: LOCTITE Sealant improves the reliability of press fits and increases their strength—replaces all sizes of lock nuts, screws and washers, jam nuts and interference threads—secures screws and locks studs—seals joints against high-pressure fluids—holds gears, rotors, armatures and fans to shafts.

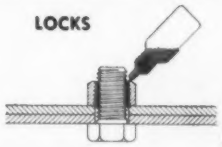
And it does this without a penny invested in equipment. LOCTITE Sealant is simple to use. It can be applied to assembled parts or applied to parts prior to assembly. The plastic container is the applicator. Where desirable, automatic or mass application procedures can easily be set up with "around-the-shop" parts and materials.

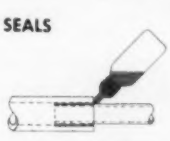
What is LOCTITE: LOCTITE Sealant is a penetrating liquid resin that hardens when confined between closely fitted metal parts. It "wicks in" between the most closely mated of matched precision surfaces and hardens into a strong, heat-, oil-, grease-, solvent- and vibration-resistant bond. There are no solvents to evaporate—no catalyst to mix.

Want to reduce costs of your production assemblies? Press fits depend on costly precise tolerances . . . the LOCTITE Method does not. LOCTITE makes a slip fit as strong as a press fit and a press fit still stronger. Thus it can be used to relax tolerances and to improve reliability. Here's one example: An anti-friction bearing with a press fit required 6,000 lbs. to remove it from its housing, while with a slip-fit and the application of a few drops of LOCTITE *it took 8,000 lbs. to remove the same bearing!*

Wherever metals are LOCKED—RETAINED—SEALED in your production assemblies, there is an opportunity to cut costs and realize better profits with the LOCTITE Sealant Method. Details on your application bring immediate response from our Application Engineering Dept. Write today.

LOCTITE GIVES YOU A DOUBLE EDGE—PRODUCTION ASSEMBLY SAVINGS AND GREATER RELIABILITY.





LOCTITE® SEALANT

American Sealants Company • 207 North Mountain Road
Hartford 11, Connecticut

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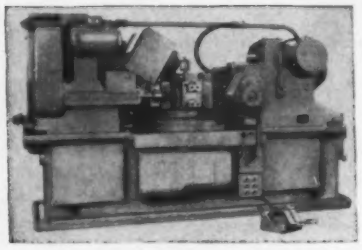


GOSS *and* DE LEEUW CHUCKING MACHINE

When any of the various functions for which this machine is designed are performed on it, no further machining is required. The job is finished.

The basic "1-2-3" method—exclusive with Goss & DeLeeuw—provides for gripping work in the chuck and machining all ends either simultaneously or in sequence. By eliminating several handlings and set-ups, the "1-2-3" method produces finished pieces at a fraction of the time and cost ordinarily required.

Send samples of your work for time estimates. Ask for illustrated literature containing detailed information.

GOSS & DeLEEUW
QUALITY · PRODUCT · QUANTITY

GOSS *and* DE LEEUW
MACHINE COMPANY, *KENSINGTON*, CONN., U.S.A.

VAN NORMAN INDUSTRIES, INC., New Bedford, Mass., has acquired the exclusive manufacturing and sales rights to a new multiple-purpose drilling and tapping machine formerly known as the "Magna Drill." The machine will be marketed under the name of "Versi-Matic."

THREADWELL TAP & DIE CO., Greenfield, Mass., a subsidiary of SHEFFIELD CORPORATION, has named

Thomas W. Clark, newly appointed president and general manager of Threadwell Tap & Die Co.

THOMAS W. CLARK president and general manager of the company. Mr. Clark, who has been a Threadwell vice-president and member of the board for the past three years, replaces ROY HELDENBRAND, who has been promoted to vice-president in charge of operations at Sheffield.

MAYO S. SILVEY has been made contract sales manager for PRATT & WHITNEY CO., INC., West Hartford, Conn. He will be responsible for contracts with the Government and prime defense contractors throughout the country.

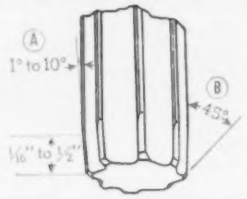
New York and New Jersey

AIR REDUCTION SALES CO., a division of AIR REDUCTION CO., INC., New York City, has announced the appointment of J. P. CASALIS, JR., as manager of the St. Louis, Mo., district. Mr. Casalis is responsible for the sale and distribution of all Airco products marketed through the district's facilities, located at 630 S. Second St., St. Louis 2, Mo. He succeeds W. M. HOLLEY, who has resigned to become an Airco distributor for the St. Louis area. F. N. ZABRISKIE has been named assistant manager—sales of Airco's midwestern

CLIP AND FILE

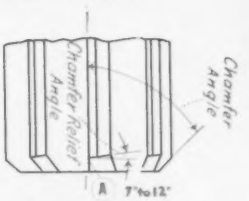
REAMING TIPS YOU CAN USE

SECONDARY CHAMFER



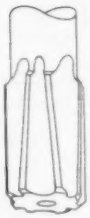
Grinding a secondary chamfer angle as illustrated (A) is often recommended. It is useful in applications where a fine finish or close tolerance is required. (B) is the regular chamfer.

KEEP IT SHARP



A chucking reamer is an end cutting tool. The cutting edges are produced by the chamfers at the ends of the lands. (A) To obtain maximum performance, the chamfers and clearance relief should be reground before excessive wear develops. Each chamfer should be ground exactly even or the tool may cut oversize.

OVERCOMING CHATTER



To end chatter in reaming, try Chicago-Latrobe's Duo-Spiral Reamer. The alternate left and right hand helixes tend to dampen cutting vibration; eliminate hogging; produce more accurate, better finished holes.

GOT A PROBLEM?

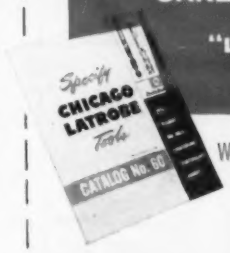
Arrange a consultation with a Chicago-Latrobe Sales or Service Engineer. His experience in hundreds of plants can lead to a quick solution of your problem.

Best tip of all...

ASK YOUR DISTRIBUTOR FOR...

Chicago-Latrobe REAMERS

DRILLS • REAMERS • END MILLS
COUNTERSINKS • COUNTERBORES
CARBIDE TOOLS • SPECIAL TOOLS and
"LO-TORK" CHIP BREAKER DRILLS



Write Chicago Latrobe or call your distributor for CATALOG No. 60. Sixty-eight pages of illustrated listings and specifications—including prices.

CHICAGO-LATROBE
428 West Ontario Street Chicago 10, Illinois

For extra aids in cutting plating rejects . . .

ask Oakite

OVER 50 YEARS CLEANING EXPERIENCE • OVER 250 SERVICE MEN • OVER 160 MATERIALS

Stop spots, add sparkle to plated parts with Oakite RINSITE® in final rinse

Just a little Oakite Rinsite in the final rinse after plating cuts rejects due to water spotting and staining. How? Rinsite "thins out" the rinse water, makes it drain more quickly, more completely.

While it leaves no drops to cause stains or tarnish . . . it *does* leave a thin, non-oily, invisible film that not only gives plated parts extra sparkle, but also protects against indoor rust.

Rinsite does a remarkable job in cold, hard rinse water. If you do tumbling operations, add Rinsite to the rinse and see how metal parts retain their newly-achieved gleam.

This liquid rinsing aid is just one of a line of Oakite materials to help avoid plating rejects. There are hard-working pre-cleaners . . . precision electro-cleaners for various metals. If you're interested in *results*, ask Oakite. Send today for Bulletin F-9822. Oakite Products, Inc., 26 Rector Street, New York 6, N. Y.

it PAYS to ask Oakite

OAKITE SCIENCE

over 50 Est. 1909 years' leadership in industrial cleaning

region. In his new capacity, Mr. Zabriskie will coordinate sales of industrial gases and equipment in the districts of Chicago, Ill.; St. Louis; Milwaukee; Minneapolis, Minn.; Davenport, Iowa; Kansas City; and Detroit, Mich.

A. SCHRADER'S SON, a division of SCOVILL MFG. CO., INC., New York City, has promoted LAWRENCE R. DOTY to the position of assistant industrial sales manager. For the past two years, Mr. Doty has been industrial sales promotion manager for the division. Located at Schrader headquarters is the SCHRADER-SCOVILL INTERNATIONAL DIVISION, which was formed recently to coordinate all

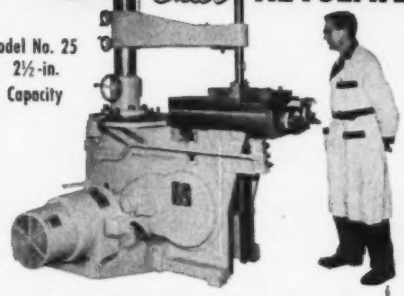
Russell C. Flood, newly named general manager, Schrader-Scovill International Division

overseas manufacturing and marketing operations of Scovill Mfg. Co., Inc. RUSSELL C. FLOOD, a vice-president of the parent company, has been named general manager of the division. Mr. Flood joined Schrader in 1930 and has served in financial and planning positions. Other management appointments to the division include FREDERIK R. STARR, as administrative manager, and FRANK FERNANDEZ, as technical manager.

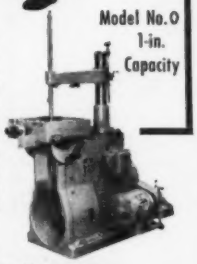
REVERE COPPER & BRASS, INC., New York City, has announced the election of JOHN C. EMISON, JR., as treasurer and WALTER R. BRENT as an assistant treasurer and manager of Revere's foreign operations. In addition, FRITZ C. HYDE and HAROLD C. WILSON have been made vice-presidents of the company.

J. ALGOT JOHNSON has been appointed vice-president in charge of research and engineering for NYLOK CORPORATION, Paramus, N. J. This

MAKE PRECISION KEYWAYS with Star KEYSEATERS



Model No. 25
2½-in.
Capacity



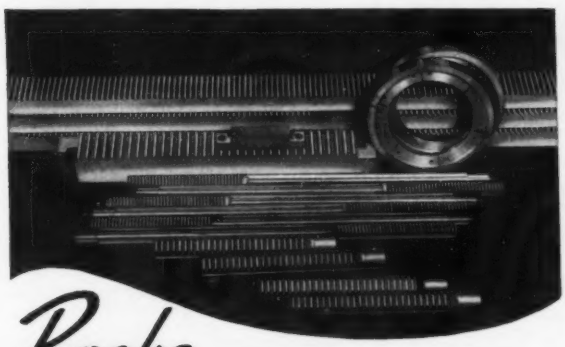
Model No. 0
1-in.
Capacity

Versatile, heavy-duty Star machines produce precision keyways in a minimum of time. Proven overarm bushing support and motorized pull-down reciprocating cutter bar action assures maximum keyway accuracy and alignment. Wedge-locked H.S.S. form tools in stock sizes from 1/8-in. to 3-in. width fit seven standard bar sizes up to 2-7/16-in. diameter. Stroke adjustable up to 24-inches. Automatic work table feed and backoff. Tilting table. Overarm column movable for cutting keyways opposite spokes.

Star Cutter Company

34500 Grand River Blvd. • Farmington, Michigan

For more data circle Item 237A



Racks.. FOR INDUSTRIAL USE —

Stahl precision is embodied in these racks, which are made in all shapes and up to 20 feet long, 3 DP. Flawless in operation, they are fabricated to your exact specifications and at prices that will please you. Stahl's skill and experience, with facilities that insure quick delivery, are at your disposal. For the finest in racks or gears it will pay you to get Stahl's estimate first.

SPURS TO 72" PD, 1 DP
BEVELS TO 54" PD, 1 DP
SPIRAL, HELICAL and WORM GEARS TO 48" PD, 2 DP
CONTINUOUS-TOOTH HERRINGBONE TO 60" PD, 2 DP
SPROCKETS TO 72" PD, 2½" CP
RACKS TO 20 FT. LONG, 3 DP
SILENT GEARS: RAWHIDE, BAKELITE, FABROIL
HEAT-TREATED, CASE OR FLAME HARDENED GEARS – OF CARBON OR ALLOY STEEL

Stahl

GEAR & MACHINE COMPANY
3901 Hamilton Ave. Cleveland 14, Ohio

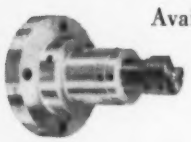
For more data circle Item 237B

SPECIFY BRINEY PRECISION ADJUSTING TOOLS

SPLIT-TENTH adjustments without loosening or tightening screws

- Pre-loaded bearings for *rigidity*
- Sealed for lifetime accuracy
- Increase production
- Reduce Scrap
- Eliminate secondary operations
- and many other features too numerous to mention

Precision Boring Quills



Available in stocked standards and specials for boring, turning, retracting, depth adjusting plus multiple adjustments.

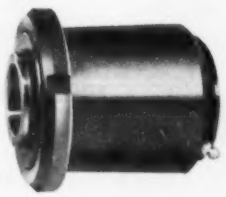
Grinding Wheel Dresser Arm

Another application of the Briney Principle for precision adjusting tools. The principle of this adjustment can be used for numerous other applications. Your inquiries are invited.

AND BRINEY

Anti-Friction Support and Pilot Bearings

NEW Briney milling machine support bearings have been re-designed for longer life and lower cost. AVAILABLE FROM STOCK.



Pilot and other special anti-friction bearings are designed to suit particular applications.

SEND FOR COMPLETE BRINEY TOOL LITERATURE TODAY

BRINEY MFG. CO.
P.O. Box 208
Pontiac, Michigan
Phone: FEderal 4-2552

For more data circle Item 237C

Synclinal Sump Type

Capacities:
5—8—10—20—30—50—75 and 100 G.P.M.

Pipe Sizes:
¾"—1"—1¼"—1½"—2"—2½" and 3".

Connections:
Coupling—Male Nipple.

By-pass Valve:
Not Available.

Synclinal Line Type

Capacities:
5—8—10—20—30—50—75 and 100 G.P.M.

Pipe Sizes:
¾"—1"—1¼"—1½"—2"—2½" and 3".

By-pass Valve:
Not available.

Operating Pressures:
Up to 80 p.s.i.

Bonded Line Type

Capacities:
10—20—30—50 and 75 G.P.M.

Pipe Sizes:
1"—1¼"—1½"—2" and 2½".

By-pass Valve:
Available with or without.

Operating Pressure:
Up to 250 p.s.i.

Operating Temperatures:
Up to 300° F.

MARVEL
SYNCLINAL FILTERS

For
DEPENDABLE PROTECTION on all Hydraulic and other low pressure circulating systems

Designed to give more ACTIVE filtering area—MORE dependable protection—MORE productive operation before cleaning is necessary. *Meet J.I.C. Standards.*

FILTERING MEDIA in all Marvel Filters is Monel wire cloth available in mesh sizes of 30-40-50-60-80-100-150 and 200 to meet your degree of filtration requirement.

EASY TO CLEAN—All Marvel Filters are easy to clean. Line type units operate in any position and may be serviced without disturbing pipe connections.

OVER 900 O. E. M's. install Marvel Filters as Standard Equipment.

In-Line Filter

Capacities:
Up to 60 G.P.M.

Pipe Sizes:
¾"—1"—1¼" and 1½" (at both inlet and outlet).

By-pass Valve:
Available with or without.

Tandem Sump Type

Capacities:
10—16—20—40—60—100—150 and 200 G.P.M.

Pipe Sizes:
¾"—1"—1¼"—1½"—2"—2½" and 3".

Connections:
Coupling—Male Nipple.

By-pass Valve:
Not available.

Bonded Sump Type

Capacities:
10—20—30—50 and 75 G.P.M.

Pipe Sizes:
1"—1¼"—1½"—2" and 2½".

Connections:
Coupling—"O" Ring—Male Nipple.

By-pass Valve:
Available with or without.

IMMEDIATE DELIVERY

A phone call can get your shipment on its way TODAY!

For further information on a specific type filter—Write—wire or phone

MARVEL ENGINEERING COMPANY
7227 N. Hamlin Ave., Chicago 45, Ill.
Phone: JUniper 8-6023

Please send me information on Marvel Filters as indicated: MY-4

☐ Hydraulic Oils ☐ Coolants ☐ Lubricants ☐ Fire Resistant Fluids
☐ Water ☐ Sump Type ☐ Line Type ☐ In-Line

Name_____
Company_____
Address_____
City_____ State_____

position formerly was held by J. E. (NED) JOHNSON, who is now president of AEROSPACE NYLOK CORPORATION, a new Nylok licensee.

Ohio

ZAGAR INC., Cleveland, Ohio, has announced that OHIO BROACH CO. will tool, distribute, and service the Zagar line of vertical and horizontal broaching machines. Ohio Broach Co. is located at 399 E. 131st Street, Cleveland 8, Ohio, in a new plant devoted exclusively to engineering and service of broaching equipment.

A. F. BOUCHER has been named general sales manager by LINCOLN ELECTRIC CO., Cleveland, Ohio. He has been with Lincoln since 1936, serving as a field engineer, district manager, and assistant general sales manager.

NEBEL MACHINE TOOL CORPORATION has moved its manufacturing, engineering, and purchasing operations to 600 N. Third St., Hamilton, Ohio. Its sales and service offices will remain at 3372 Central Parkway, Cincinnati 25, Ohio.

DANA CORPORATION, Toledo, Ohio, has announced the appointment of VON R. KAUFMAN as manager of the Toledo division. He replaces JOHN H. JONES, who has been appointed assistant to the vice-president in charge of manufacturing. Mr. Kaufman has been president and general manager of HAYES STEEL PRODUCTS LIMITED, Canadian affiliate of Dana Corporation in Merritton, Ontario, Canada; president of B-W-H SERVICE PARTS LIMITED, a subsidiary of Hayes; as well as a director of Hayes, B-W-H, and KELSEY WHEEL CO., Windsor, Ontario.

Von R. Kaufman, manager—Toledo division, Dana Corporation

A Grieder Tube Cut-Off Machine will produce 4500 to 6500 cut-offs per hour

Grieder Tube Cut-Off Machines are 3 to 8 times faster than others, and speed is only one of the cost saving advantages they provide. For example:

- $ Cut tubing of any shape to any length—steel, copper, brass, aluminum and alloys. Continuous automatic operation.
- $ Lengths can be held to plus or minus .002" on light wall tubing and to .003" on heavier.
- $ Precision clamping dies prevent tube distortion and produce a quality cut. Tube does not rotate.
- $ Thousands of cuts without grinding. Blades can be sharpened on standard tool room equipment and used for as many as a million cuts.

Write for literature, stating tube sizes and production requirements.

Grieder
TUBE CUT-OFF MACHINES

GRIEDER INDUSTRIES, INC.
P. O. Box 169 • Bowling Green, Ohio

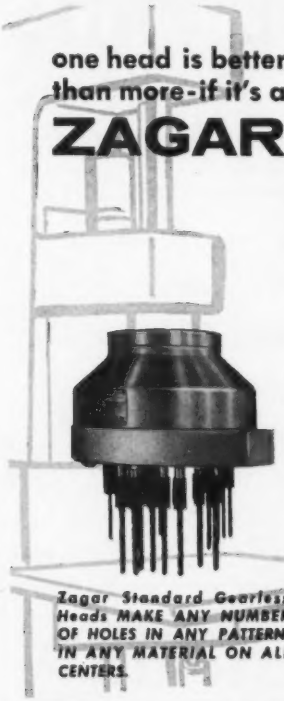
Please send bulletin describing Grieder Tube Cut-Off Machines.

NAME_____
COMPANY_____
CITY_____ ZONE____
STATE_____

For more data circle Item 239A

one head is better than more-if it's a

ZAGAR Head for Drilling, Reaming and Tapping



1 to 1000 holes in one pass—as close as twice drill diameter. Costs decrease as spindles are added. *And,* a variety of hole patterns (or parts) can be produced with one *fixed center head.* Zagar units are adaptable to standard drill presses or are built as a complete installation. Send in your hole problem to Zagar.

Zagar Standard Gearless Heads MAKE ANY NUMBER OF HOLES IN ANY PATTERN, IN ANY MATERIAL ON ALL CENTERS.

Write for Manual "M-4" for engineering data.

Zagar 23888 LAKELAND BLVD. • CLEVELAND 23, OHIO INCORPORATED

USE MORE SPINDLES TO DO MORE WORK

For more data circle Item 239B

MAY-FRAN CHIP CONVEYOR

MAY-FRAN *makes a standard chip conveyor for every machine tool*

MAY-FRAN MANUFACTURING CO.
1710 CLARKSTONE RD.
CLEVELAND 12, OHIO
PHONE: KE 1-2304

For more data circle Item 239C

Eugene L. Mackey, vice-president —engineering for Yoder Co.

Elmer A. Koenig, vice-president in charge of sales, Yoder Co.

YODER CO., Cleveland, Ohio, has appointed EUGENE L. MACKEY vice-president in charge of engineering. In his new capacity, Mr. Mackey will assume full responsibility for the product engineering, test engineering, standards, research, and technical services to the company's sales department. In addition, ELMER A. KOENIG has been named vice-president in charge of sales, with responsibility for the company's over-all national and international sales activities and its customer services.

Pennsylvania, Maryland, and District of Columbia

PHILADELPHIA GEAR CORPORATION, King of Prussia, Pa., has announced the appointment of WILLIAM T. BROWN as vice-president in charge of manufacturing and HAROLD O. KRON as vice-president in charge of engineering. Mr. Brown came to Philadelphia Gear in 1934, and has served in the capacities of foreman, plant superintendent, and plant manager. Mr. Kron joined the firm in 1948, and has been serving as chief engineer prior to this appointment.

RAGNAR CARLSTEDT, designer of tools and metalworking machines has become associated with KENNAMETAL INC., Latrobe, Pa., to develop certain specialized applications of carbide tooling. A native of Sweden, Mr. Carlstedt for some years headed a Stockholm firm which manufactured specialized machine tools, measuring instruments, tools and dies.

ROTOR TOOL CO., Cleveland, Ohio, has announced the appointment of JOHN S. HOWEY and EDGAR E. JONES as direct factory representatives for the Pittsburgh, Pa., area. Mr. Howey has had wide experience in industrial, management, and engineering fields. "Special Delivery" Jones is in a position to advise on any industrial power tool problems.

DREW W. PERKINS has been made engineering director of BERYLLIUM CORPORATION, Reading, Pa. Mr. Per-

LITTLE GIANT **CONDENSATE UNITS**

SPECIFICALLY DESIGNED FOR YOUR NEEDS

Little Giant condensate units are especially designed to fit any mechanical refrigeration or air conditioning unit for condensation removal. Available with positive displacement double pole switch, depending on model. Sturdy metal tanks resist corrosion. Available for 115V, 60 cycle or 230V single phase.

For complete specifications, contact:

Little Giant
PUMP COMPANY
DIVISION OF LITTLE GIANT CORPORATION
3810 N. Tulsa • Oklahoma City, Okla.

DEEP HOLE DRILLING

Single or Multiple Spindle

* **STEP AND REPEAT ACTION—*NO SHOCK***
  The number of steps possible is infinitely variable—to satisfy any requirement.
* Reduces breakage and over-heating of drills.
* Can be added to existing machine, or used to replace old style units.
* Adaptable to any single or multiple—spindle application.
* Self contained—Compact

Write for Literature

* Available in from 1 to 5 H.P. —up to 12" Stroke

Typical example of a multiple spindle unit drilling in medium hard cast iron.

A Drillunit—5 H.P. Capacity will drive
10 ¼" dia. drills
or 6 ⅜" dia. drills
or 4 ½" dia. drills
or 3 ⅝" dia. drills
or 2 ¾" dia. drills
or 1 1" dia. drill

DRILLUNIT, INC.

HYDRAULIC DRILL UNITS

3267 Wight Street • Detroit 7, Michigan

For more data circle Item 241A

DYKEM STEEL BLUE

Stops Losses making Dies and Templates

Popular package is 8-oz. can fitted with Bakelite cap holding soft-hair brush for applying right at bench; metal surface ready for layout in a few minutes. The dark blue background makes the scribed lines show up in sharp relief, prevents metal glare. Increases efficiency and accuracy.

Write for sample on company letterhead

THE DYKEM COMPANY

2303R North 11th St. • St. Louis 6, Mo.

CUT SCRAPER TIME

END NIGHT CLEANUP & MORNING REBLUING

DYKEM HI-SPOT BLUE No. 107 is used to locate high spots when scraping bearing surfaces. As it does not dry, it remains in condition on work indefinitely, saving scraper's time. Intensely blue, smooth paste spreads thin, transfers clearly. No grit; noninjurious to metal. Uniform. Available in collapsible tubes of three sizes. Order from your supplier. Write for free sample tube on company letterhead.

THE DYKEM CO., 2303R NORTH 11TH ST., ST. LOUIS 6, MO.

For more data circle Item 241B

CAMS

ALL TYPES MADE TO YOUR SPECS!

CAM CALCULATING SERVICE

Write for catalog 55-C

EISLER ENGINEERING CO., INC.
Chas. Eisler, Jr., President

738 South 13th Street
Newark 3, New Jersey

For more data circle Item 241C

Greenerd PRESSES

• FORMING • STRAIGHTENING • SIZING • STAMPING •

• PRESSING • ASSEMBLING • BROACHING • FORCING •

for . . .

- ASSEMBLING
- BROACHING
- EXPANDING
- FORMING
- MOLDING

ETC.

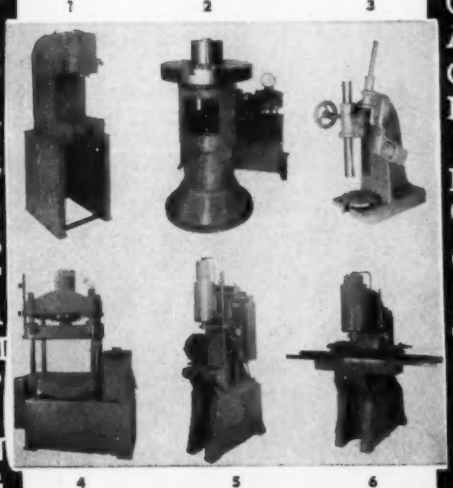
GREENERD hand operated Arbor Presses are built in plain lever type, lever ratchet type, and larger sizes compound geared with two pinions meshing with the rack. Smaller sizes may be furnished with pilot wheel in place of lever.

Write for Catalog M-42.

GREENERD Hydraulic Presses are used for push broaching, forming, straightening, testing of dies, and many other uses, as well as production assembly work.

Write for Catalog M-46.

#1—2 Ton Fast Hydraulic Press
#2—Metal Expanding Machine from 40-300 Ton Capacity
#3—Arbor Presses ¼ to 30 Ton
#4—Guided Platen Hydraulic Presses
#5—C-Clamp Hydraulic—2 to 30 Ton
#6—Straightening Press—15 Tons Spring centers on ball bearings



Sold by Machine Tool Dealers and Mill Supply Houses throughout the world.

Greenerd ARBOR PRESS CO.

41 CROWN ST. NASHUA, N.H.

For more data circle Item 241D

kins will direct all engineering activities at the corporation's alloy plant in Reading and its beryllium metal facility at Hazleton, as well as other engineering requirements for the corporation's headquarters.

BIRDSBORO CORPORATION, Birdsboro, Pa., has announced a reorganization of key personnel in its Reading hydraulic division. HAROLD C. SPROULE has been named division manager and JOSEPH C. STAVER, formerly chief estimator, has been promoted to chief engineer of the division.

W. L. VAN WINKLE has been appointed sales manager of the small-diameter rolls manufacturing division of Voss ENGINEERING, Pittsburgh, Pa.

CRUCIBLE STEEL COMPANY OF AMERICA, Pittsburgh, Pa., has named G. W. SNYDER assistant to the vice-president, commercial department, and director of production control. JOSEF H. BUERGER, JR., has been appointed director of sales for the company. He will direct field sales through five regional managers and thirty-eight sales offices and warehouses. He will also supervise the managers of all product divisions.

G. W. Snyder, assistant to vice-president, commercial department, and director—production control, Crucible Steel Company

The appointment of JOHN D. GOODELL as president and general manager of the USI ROBODYNE DIVISION, Silver Spring, Md., has been announced by U. S. INDUSTRIES, INC., New York City. Mr. Goodell was previously director of engineering at Robodyne, and was concerned with the development of the TransfeRobot line of industrial automation equipment.

EUGENE J. KOSCHELLA has become a member of the staff of the National Machine Tool Builders' Association, Washington, D. C. Mr. Koschella joined NMTBA after having completed the special apprentice program and serving in various engineering positions at WARNER & SWASEY CO.

Eugene J. Koschella, new member on staff of National Machine Tool Builders' Association

the Modern Way
TO CUT OFF AND FORM TUBING AND BAR STOCK IN A SINGLE OPERATION
Here is a combination that feeds tubing and bar stock — automatically — to a fast, automatic cutting-off machine. Best of all, the pieces being cut off can be formed, grooved, flanged or chamfered at the same time.
There are models that handle tubing, pipe and bar stock from 1/8" diameter up to solid bar stock of 3" OD and tubing up to 8" OD.
Why not investigate?
WRITE FOR CATALOG
MODERN MACHINE TOOL CO.
2005 Losey St. • Jackson, Michigan
FREE TRIAL OFFER. Safe, positive, fast set-ups. The Modern Safety Drill Table handles odd, irregular shapes without V-blocks, clamps or parallels. Ideal for maintenance work. Guaranteed to save its cost in labor alone every 6 months. Sizes from 8" to 27½" dia. Try it at our expense. No obligation.

A MAJOR BREAKTHROUGH

ON

ENGINEERING

CAMS

by the world's leading **CAM** manufacturer

Write for Bulletin No. 105
which completely details and outlines
how you can

SAVE 2,300%

on engineering computation alone

EONIC *Inc.* | *automated* **CAM** *engineering*

464 E. Hollywood Ave. • Detroit 3, Michigan

For more data circle Item 243A

AUCTION

HEAVY METAL FABRICATING MACHINERY

Tool Room Equipment • Materials Handling Equipment of

K. R. WILSON, Inc.

370 Babcock St., Buffalo, New York

Formerly the Plant and Equipment of

AMERICAN CAR & FOUNDRY COMPANY

WED. & THURS., APRIL 12-13, 1961 on PREMISES

STARTING AT 10 AM EACH DAY

Exhibition: April 5 to day of sale, during business hours

Sale Includes:

BORING MILLS Cinn. Hypro 100" Vert.; G & L #50F Horiz.; Bullard 60" M-Axi-Mill Vert.; Ryder-Wellman 3" Horiz.; Bullard 54" VTL; Bullard 34" VTL **MILLING MACHINES** Cinn. 18" dual head auto.; Cinn. size 2-18 R & F; B & S #3 Vert.; B & S #2A Univ.; Cinn. #4 Vert.; Van Norman #3; K T Milwaukee #3 Univ.; P & W #2A Jig Bore. **RADIAL DRILLS** Amer. 4' x 13"; Cinn-Bick. 4' x 13"; Miles #10-6'; Cinn.Bick. 6' x 14". **LATHES** 2 Monarch model CW 16" x 136"; L & S 48" x 23'; Amer. 32" x 15'; Amer. 36" x 16'; Gisholt #3 Turret; 3 B & O #5 Univ. 18" x 54"; 10 Asstd. Tool Room Lathes. **SHEARS** Nnagara 10' #910. **BRAKES** Sturdy Bender 30 ton 8'; Steelweld 10'. **METAL SAWS** Do All ZV160-26 & 36-R Band Saws. **PRESSES AND PUNCHES** Watson-Stillman 600 ton Hyd.; Kling h.d. Punch. **PLANERS & SHAPERS** Cinn. Hypro. 26' x 96", Cinn. 24" x 8' & 18" x 60"; Rockford 24" Shaper; Clark 15000 & 6000 lb. Fork Lifts; Plymouth Yard Switch Engine; Miscellaneous Perishable Tools, Tooling. **GRINDERS** Landis type D Hyd.; Landis #4 H; B & S #1 Univ Cyl.; B & S #13 Univ. T C; 8 Abrasive #3 Surf. **COMPRESSORS** C-P 250 hp Duplex; 2 I-R 50 hp mod. 50; A-E 150 hp, 100 KW; F-M 50 KW Diesel; 3 Shepard-Niles 5 & 10 ton 84' Bridge Cranes; 17 Asstd. Hoists ¼ to 3 ton. 22 Welders 500 & 1000 amp; Westinghouse 250 KVA X-Ray Unit; Pangborn Blasting Machines; Degreaser; Heat Treating Ovens; Office Equipment, etc.

Write for Detailed Catalogue

SAMUEL T. FREEMAN & CO. Auctioneers

1808 Chestnut St., Phila. 3, Pa.

For more data circle Item 243E

TRIAL SAMPLE!

SPECIAL LUBRICANT EASES WORKING STAINLESS AND TOUGH METALS

New lubricant eases stamping and machining operations on the toughest metalworking jobs—takes the problems out of hard-to-work metals such as stainless, high carbon, high chrome, cast iron, monel, etc. Scientifically developed ANCHORLUBE now used extensively in a wide range of applications—drilling, tapping, spot facing, counter-boring, milling, fly-cutting, seat forming, engraving, broaching, drawing, piercing, punching, hole extruding, etc. Application by swab, spray, roller or brush. Send today for free trial sample and see for yourself how easy you can work the job with ANCHORLUBE.

ANCHOR CHEMICAL COMPANY

Dept. M-4 • 10721 Briggs Road • Cleveland 11, Ohio

For more data circle Item 243B

For just $3.00 you get ANSWERS!

Answers to hundreds of questions. BEND? CUT? Then you should have in your library "A Manual of Processes for The Cold Bending of Metals and Abrasive Cut-Machining of Metals."

Order yours today

WALLACE MFG. COMPANY

1310 W. Diversey Parkway Chicago 14, Illinois

For more data circle Item 243C

GEARS—ALL MAKES . . .

Special and standard

PRECISION GEARS UP TO 200 DIAMETRAL PITCH

All Gears certified for Accuracy

Quality and Fine Workmanship

NEW JERSEY GEAR & MFG. CO.

1470 Chestnut Ave. Hillside, N. J.

For more data circle Item 243D

Ettco

DRILLING and TAPPING

Lead Screw tapping attachments and heads

Here's precision production! Complete uniformity with unskilled labor. The result is speed, accuracy and economy, regardless of quantity.

Complete Line-Ettco has the tool for your single or multiple small hole production job.

ETTCO TOOL AND MACHINE CO., Brooklyn 37, N. Y.

For more data circle Item 243F

Obituary

ROGER HEALD, president of HEALD MACHINE CO., Worcester, Mass., died on January 25. Born in Barre, Mass., in 1896, he was the eldest of the late JAMES N. HEALD's four sons. The family moved to Worcester in 1903 when Mr. Heald's father brought the business there. After attending Worcester Academy and Worcester Polytechnic Institute, he joined the company in 1919. Mr. Heald's interest was mainly in production, and after thorough training and experience, he was named production manager in 1924 and works manager in 1928. In 1920 he was elected to the board of directors, in 1924 vice-president, and in 1931—upon the death of James N. Heald—he accepted the responsibilities of president of the company.

New Book

MODERN MATERIALS, VOLUME II: ADVANCES IN DEVELOPMENT AND APPLICATIONS. Edited by Henry H. Hausner. 397 pages; 6 by 9 inches; illustrated. Published by Academic Press Inc., 111 Fifth Ave., New York 3, N. Y. Price, $12.50.

This second volume of *Modern Materials*, a series covering materials and their properties which are of prime interest in today's engineering, contains seven chapters written mostly on a high engineering level. Mathematics has been introduced only where absolutely necessary for the understanding of the subject. The seven chapters are written by experts in their fields, from the United States as well as from Sweden. The information given should be useful to a great variety of scientists as a means of becoming acquainted with engineering problems; to engineers, in becoming acquainted with materials other than those of their field of specialization; and to students, as a stimulus to becoming interested in and acquainted with material problems.

Chapter titles are: Polymer Modified Papers; Modern Flame-Sprayed Ceramic Coatings; Ceramics for Cutting Purposes; Borides (Part A—Basic Factors, Part B—Fabrication, Properties, and Applications); Titanium Metallurgy; Welding Materials; and Soldering Materials—Their Production, Properties, Application.

Coming Events

APRIL 18-20—Annual Welding Exposition, sponsored by the American Welding Society, to be held at the New York Coliseum. Concurrently (April 17-21), the society will hold a technical meeting at the Commodore Hotel, New York City. For more details: AWS Information Center, American Welding Society, 33 W. 39th St., New York 18, N. Y.

MAY 1 - 2 — Forty - third Annual Meeting of the American Zinc Institute, to be held at the Drake Hotel, Chicago, Ill. For more details, contact G. M. Basford Co., 60 E. 42nd St., New York 17, N. Y.

MAY 22-25—Design Engineering Show, to be held in Cobo Hall, Detroit, Mich. For further detail, inquire of Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N. Y.

MAY 22-26—ASTME Tool Show, to be held in New York Coliseum. For additional information, contact Leonard Abrams, American Society of Tool and Manufacturing Engineers, 10700 Puritan Ave., Detroit 38, Mich.

NEW SUPER CYCLE POWER QUILLS

Extend your range of precision grinding, milling and finishing—step into high production with the new line of Precise Super Cycle Power Quills. These new units provide constant speed operation with no speed drop under load . . . run at speeds from 7,200 rpm to 60,000 rpm . . . assure excellent surface finishes, longer life for abrasive wheels and carbide midget mills. Rotor has no windings, no commutator — never needs servicing. Super Cycle Power Quills (with converters) are available in four basic models — provide up to 2 hp output at the chuck. All Super Cycle Quills are interchangeable with Precise Universal Motor Power Quills.

CONVERTERS—Self-contained, portable converters for Super Cycle System. Single, four-speed and continuously variable models.

Precise

Grinder-Millers, Power Quills, Jig Grinders, Milling Machines, Automatic Drill Units, Cutting Tools, Vapor-Lub Cooling, Sklero Hardness Tester

Quality and Precision Since 1882

PRECISE PRODUCTS CORPORATION
3751 Blue River Road, Racine, Wisconsin, U. S. A.
Branch Plant: Precise, G. m. b. H., Duesseldorf, Germany

For more data circle Item 244A

small parts straighteners

Flat, accurate stampings save hours of assembly time, work better and last longer where flatness is important to performance, paint and plate easier and look better.

Low cost Cooper Weymouth straighteners are fast, accurate, automatic, straighten small parts, coils or strips to .001" - .002". A unique two-point adjustment gives fast, easy, precise set-up. Machined steel housings, hardened and ground rollers and anti-friction bearings insure longest life. A 4 gear-train drive equalizes bearing loads, gives smoother high-speed operation. Self-contained and self-powered with variable speed controls, straighteners are available in bench-height cabinet or portable models, in four sizes.

Also inquire about other Cooper Weymouth cost-saving automatic press room accessory equipment.

COOPER WEYMOUTH, INC.
603 Honeyspot Road, Stratford, Conn.

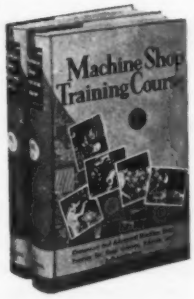
For more data circle Item 244B

Classified and Resale Section

CLASSIFIED ADVERTISING RATES: $16 per single column inch

MACHINE SHOP TRAINING COURSE

By Franklin D. Jones



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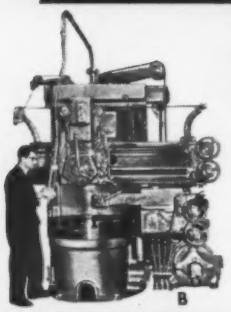

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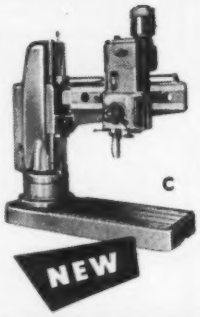

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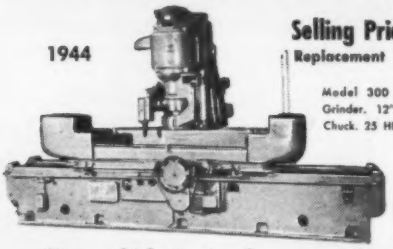

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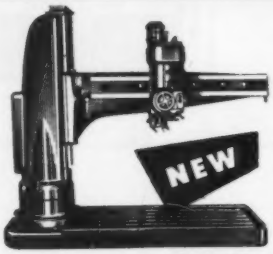

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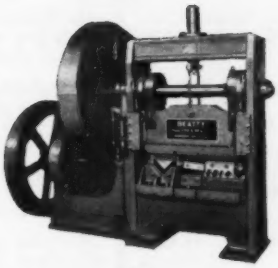

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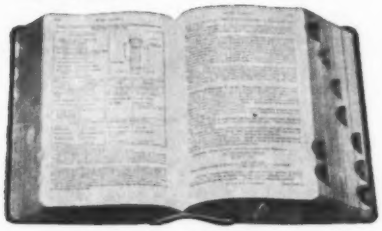

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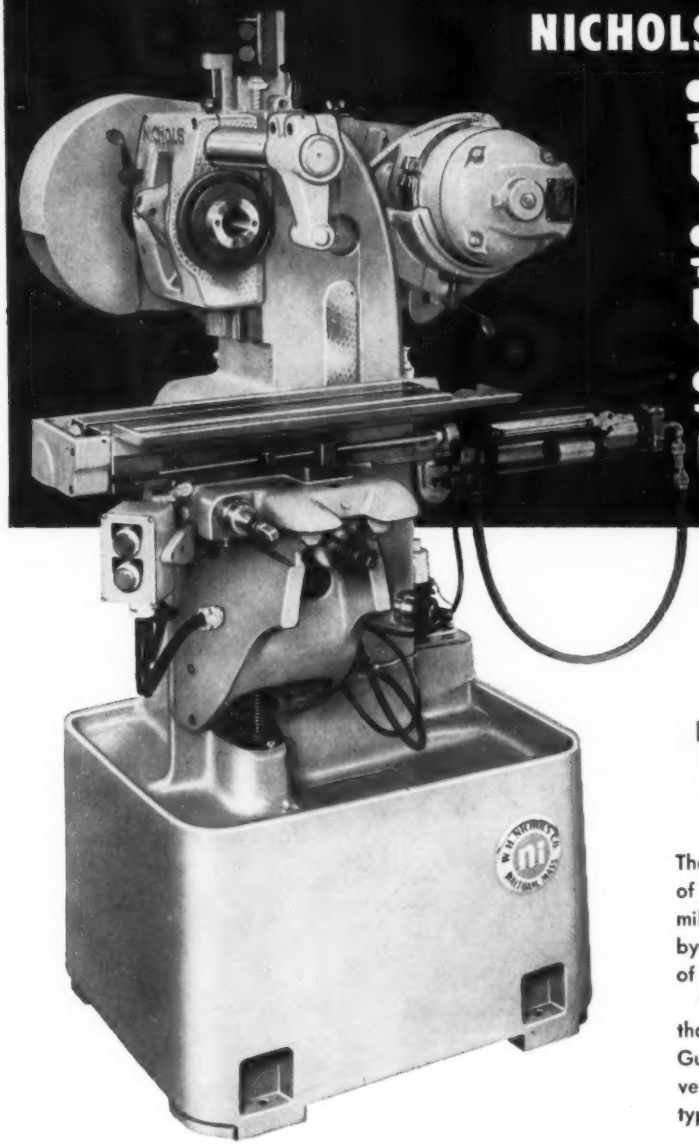

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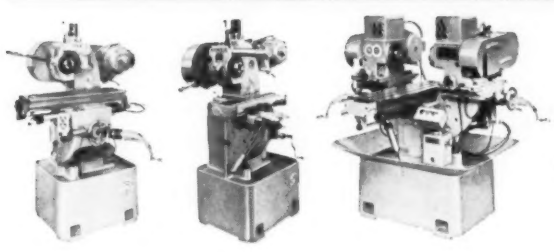

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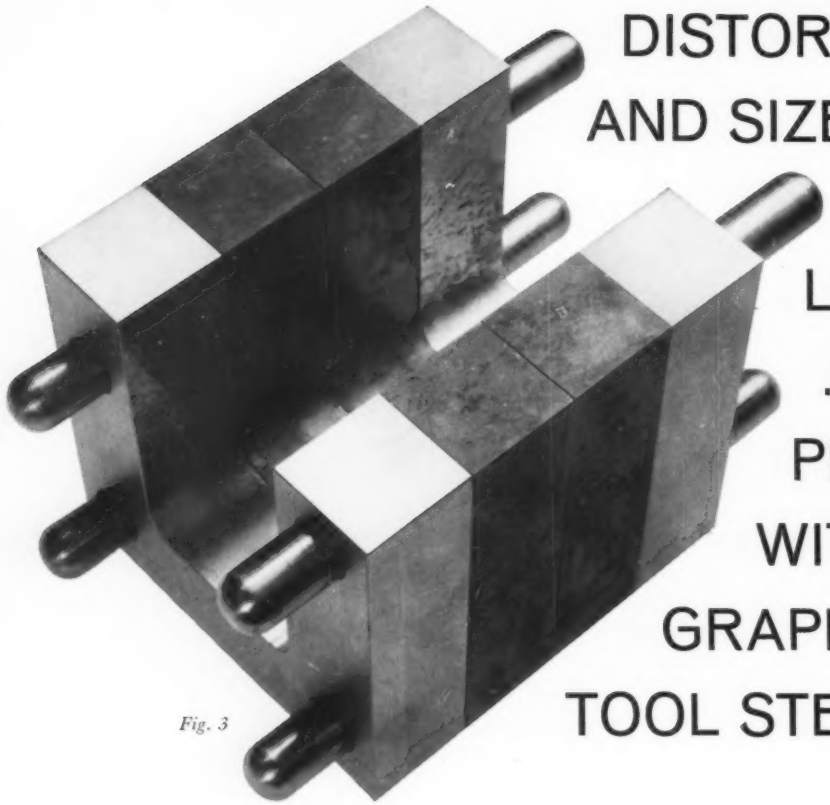

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Fig. 3

The test pieces pictured here demonstrate the dimensional stability of Graph-Air® tool steel that enables users to produce more intricate tools and dies.

Fig. 1 shows test piece dimensions. In the "U" shape, which is particularly sensitive to distortion in heat treating, the machining tolerance between any two holes is held to .0002". After heat treating, the specimens are fitted together by four pins having a diameter of .0003" under .500". The total assembly error under these circumstances could not exceed .0008". Distortion must be less than .0002" per inch during heat treatment for the pins to fit.

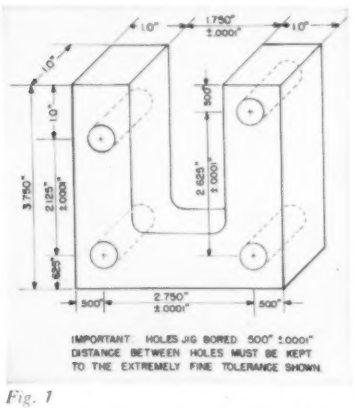

Fig. 1

The Graph-Air pieces tested were from different heats. They were air hardened from 1450°F. and double tempered at 400°F. Fig. 2 shows them as they pegged together easily, demonstrating no distortion. Fig. 3 top, shows the same specimens compared with two green, or as machined, parts. They matched perfectly again. *Graph-Air did not distort . . . did not change size.* Records indicate that no other tool steel passed this test when heat treated at its recommended hardening and tempering conditions.

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